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HUMAN COMPUTER INTERFACE SPECIFICATIONS (HCIS) FOR THE INTEGRATED MAINTENANCE INFORMATION SYSTEM (IMIS)

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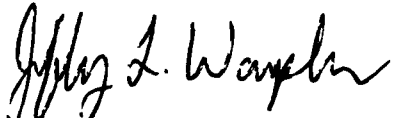
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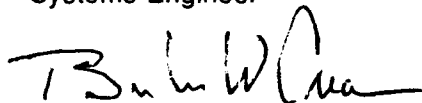
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The Public Affairs Office has reviewed this paper and it is releasable to the National Technical Information Service, where it will be available to the general public, including foreign nationals.

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13. ABSTRACT (Maximum 200 words)

The Armstrong Laboratory Logistics Research Division (AL/HRG) is developing a proof-of-concept Integrated Maintenance Information System (IMIS). The IMIS will demonstrate the capability to access and integrate maintenance information from multiple sources and present the information to technicians and maintenance personnel through hand-held and workstation computers. A significant part of IMIS is the user interface. Current practices in the DoD procurement process do not emphasize the specification of a system's user interface as requirements. Instead, the user interface is often designed as the system develops. This paper documents a baseline user interface specification for all IMIS applications and a detailed user interface specification for an interactive electronic technical manual (IETM) presentation system.

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PREFACE

This report provides an initial description of the Integrated Maintenance Information System (IMIS) user interface. The work was performed by a combination of organizations supporting the demonstration IMIS development. IMIS is being sponsored under General Dynamics Electronics (GDE) Contract No. F33615-88-C-0024 and General Dynamics Fort Worth (GDFW) Contract No. F42600-89-D-0685.

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ACRONYMS AND ABBREVIATIONS

2D	Two Dimensional
3D	Three Dimensional
AFTO	Air Force Technical Order
AIP	Aircraft Interface Panel
AL/HRG	Armstrong Laboratory, Logistics Research Division
API	Application Programmers Interface
ASA	Applied Sciences Associates, Inc.
CAMS	Core Automated Maintenance System
CDM	Content Data Model
CEMS	Comprehensive Engine Management System
DoD	Department of Defense
FOC	Follow-On Conditions
FSCN	Federal Stock Code Number
GCSFUI	General Content, Style, Format, and User-Interface
GDE	General Dynamics Electronics Division
GDFW	General Dynamics Fort Worth Division
HCIS	Human Computer Interface Specification
IETM	Interactive Electronic Technical Manual
IMIS	Integrated Maintenance Information System
IMIS DM	Integrated Maintenance Information System Diagnostic Module

ACRONYMS AND ABBREVIATIONS (Cont'd)

IPB	Illustrated Parts Breakdown
JCALS	Joint Computer-Aided Logistic Support
LCD	Liquid Crystal Display
MIL-STD	Military Standard
MIW	Management Information Workstation
NSN	National Stock Number
O-Level	Operational Level
OH	Overhead
OI	Object Interface
PC	Personal Computer
PDR	Preliminary Design Review
PMA	Portable Maintenance Aid
QTY	Quantity
RC	Required Conditions
R&D	Research and Development
SBSS	Standard Base Supply System
SDD	Software Design Document
SUPP INFO	Supplemental Information
TBD	To Be Determined
TK	Tool Kit
TO	Technical Order

ACRONYMS AND ABBREVIATIONS (Cont'd)

UI   User Interface

WUC   Work Unit Code

SUMMARY

This technical paper describes work in progress on a User Interface Specification for the Integrated Maintenance Information System (IMIS). The IMIS is a research and development (R&D) effort being conducted by the Armstrong Laboratory, Logistics Research Division (AL/HRG) to access and integrate maintenance information from multiple sources and present necessary information to maintenance personnel through portable and desk-top computers.

This specification is the culmination of several years of R&D performed by AL/HRG. The Human Computer Interface Specification (HCIS) encompasses software and hardware user interface (UI) requirements for a proof-of-concept demonstration IMIS. The HCIS defines the way each user interface type will look and behave. It describes generic UI components (e.g., pop-up menus and pointer/cursor movement) and a specific instance of an application (technical order presentation). The level of detail provided in the HCIS will be enough for geographically separated developers to build human-computer interfaces that are consistent in their look and behavior.

The HCIS is a baseline specification. It is anticipated that changes will occur as the demonstration IMIS is developed. Upon completion of the project, the baseline HCIS will be updated and will represent the final UI of the demonstration IMIS.

1.   INTRODUCTION

The Armstrong Laboratory, Logistics Research Division (AL/HRG) is developing a proof-of-concept Integrated Maintenance Information System (IMIS) (Link et al., 1987). The IMIS will demonstrate the capability to access and integrate maintenance information from multiple sources and present the information to technicians and maintenance personnel through hand-held and workstation computers. Results of the program will form the basis of requirement specifications for such a system. Specifications developed by the project will be proven effective through rigorous field evaluations by Air Force maintenance technicians. As a result, IMIS will improve the capabilities of maintenance organizations to efficiently use available manpower and resources, and effectively meet combat sortie-generation requirements.

The modern maintenance environment is being increasingly inundated with computer-based information systems. Examples include the Core Automated Maintenance System

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(CAMS), Standard Base Supply System (SBSS), the Comprehensive Engine Management System (CEMS), and the Joint Computer-Aided Logistic Support (JCALS) System. Additionally, many aircraft systems contain on-aircraft diagnostics capabilities (built-in tests) which require technicians to interact with various displays in the cockpit to perform their job. Soon, Interactive Electronic Technical Manuals (IETMS) will be introduced into the maintenance world, adding yet another computer aid. Each new maintenance aid forces technicians to learn yet another system. The IMIS is being developed by AL/HRGO to facilitate the use of the valuable information these systems offer while eliminating the specialization required for each.

The IMIS will consist of a Maintenance Information Workstation (MIW) for use as a server and as an interface to the standard base-level computer systems, a Portable Maintenance Aid (PMA) for flight-line use, and an aircraft interface panel (AIP) for interacting with aircraft systems. The PMA will be a very small, portable computer/display which will display IETMs, present troubleshooting diagnostics aids (Cooke et al., 1991), and interface with on-aircraft systems (via the 1553 bus) and ground-based computer systems (via Radio Frequency to the MIW). The PMA will provide a single, integrated source of the information needed to perform maintenance on the flight line.

One of the most important aspects of a new computer application, such as IMIS, is the UI. The UI is the layout and presentation of information on the computer screens and the controls used to work with the presented data. The technician does not care how the internal system works, only that the application is easy to learn and supports his/her work efficiently and effectively.

Unfortunately, Military Standard (MIL-STD) 2167A, the standard for software procurement (Department of Defense [DOD], 1988), does not require a mechanism for UI specifications in the formal procurement process. UIs are often built as the system develops, leaving little room for change without causing major impacts on cost/schedule.

The IMIS Statement of Work was based on MIL-STD-2167A and did not contain any requirement for UI specifications. To attack this problem, a UI working group was formed prior to Preliminary Design Review (PDR) to specify a baseline UI for IMIS. The working group consisted of software and human factors representatives from the lab, the prime contractors, and their subcontractors. Previous laboratory/contractor documents and draft DoD specifications were used as a starting point for the UI (Corner, 1990; DTRC/AFHRL/AFLC, 1992a; DTRC/AFHRL/AFLC, 1992b; Moorman & Quill, 1991;

Quill, 1992). Building upon these initial documents, the working group developed a UI specification for the IMIS called the Human Computer Interface Specification (HCIS).

The challenge of developing a consistent UI is compounded by the fact that IMIS is being developed by two geographically separated developers: General Dynamics Electronics Division (GDE) and General Dynamics Fort Worth Division (GDFW). The GDE team is responsible for integration of information (i.e., interplatform communications, external data communication, and software modules) and the display of nontechnical manual maintenance information (Work Order, Debrief, Schedules, Parts Ordering, etc.). GDFW is responsible for authoring and displaying the electronic technical manuals or IETMs.

The IMIS project is employing graphical UI techniques to enhance the presentation of maintenance data. Current technology provides UI styles, such as MOTIF (Open Software Foundation, 1991). The IMIS contractors are using tool kits (TKs) which support such styles. However, these TKs provide much flexibility and, therefore, implementation by several teams may lead to an inconsistent UI. The HCIS details a specific UI to ensure consistent interaction with maintenance data.

The purpose of the HCIS is to ensure the development of consistent and user-friendly interfaces across IMIS platforms and maintenance information types. This involves providing a format from which independent developers can develop applications that will fit into the set of IMIS applications in a seamless fashion. Using the HCIS will make all IMIS applications seem as one.

The scope of the HCIS encompasses the software and hardware UI requirements for IMIS. It describes generic UI components in Sections 1 through 7 (e.g., pop-up menus and pointer/cursor movement) which apply to all IMIS applications, and a specific instance of an IMIS application in Section 8 (i.e., Technical Order [TO] Presentation)[1]. The level of detail provided is enough for geographically separated developers to build applications that are consistent in their look and behavior.

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[1] The TO presentation system assumes the presence of TO data developed in a format compliant with the IETM-Data Base, a type C data specification promulgated by AL/HR (DTRC/AFHRL/AFLC, 1992a). The IMIS UI is specified in terms of generic UI requirements and specific implementations of the generic requirements. The generic UI description is contained in this paper. Except for TO Presentation, the specific implementation designs (storyboards and state transition diagrams) are contained in the IMIS Software Design Document (SDD) (General Dynamics Electronics Division, 1992).

Note that several appendices support this paper by providing additional information pertaining to the UI design. The HCIS is a baseline specification, but several changes have occurred between the time the baseline was established and press time. See Appendices A, B, and C for recent changes to the HCIS.

2. IMIS HARDWARE

The IMIS hardware consists of the MIW, PMA, and AIP hardware segments. Each display device, or segment, will have a common set of functions which allow the user to interact with the data being presented. A brief description of the segments and functions are contained in the following sections.

2.1 Maintenance Information Workstation Hardware

The MIW hardware consists of a SUN Sparcstation 1 with a mouse input device, a 19-inch color monitor with a resolution of 1160 x 1280 pixels, and a personal computer (PC)-style keyboard. The keyboard layout for the MIW hardware platform is shown in Figure 2-1. A template will be used to supply the function keys on the MIW keyboard with IMIS-specific function labels.
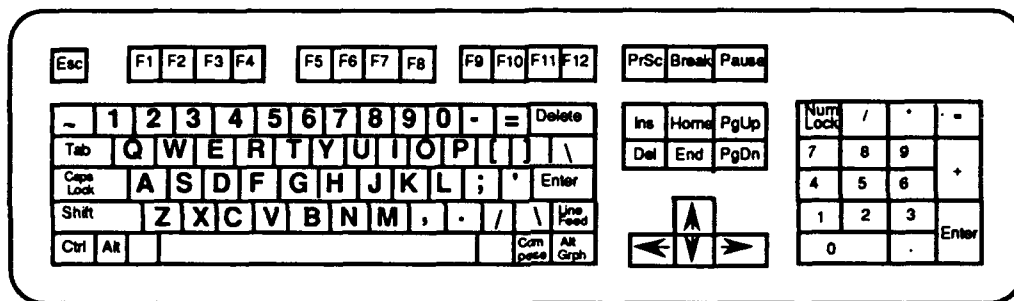
Figure 2-1: Maintenance Information Workstation Keyboard

2.2 Portable Maintenance Aid Hardware

The PMA is a 10.5-x-9.5-x-2.5-inch, six-pound device. The display screen is an 8-x-6-inch transflective Liquid Crystal Display (LCD) with a 640-x-480 pixel resolution. There are 30 keys on the device. The actual keypad color is specified according to MIL-STD-1472D (DoD, 1989) as being Grey Number 26492 with Black Number 17038 lettering. Key labels will be printed in all capital letters. An example layout for the PMA is shown in Figure 2-2.
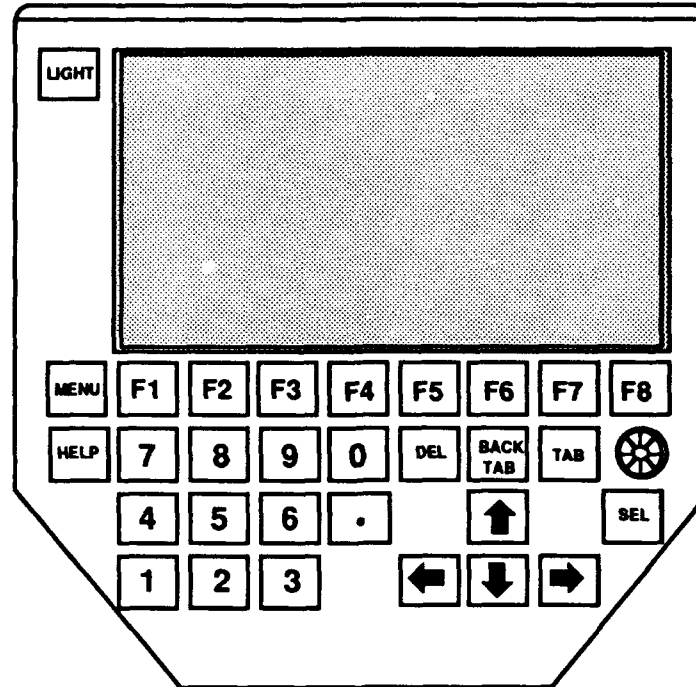
Figure 2-2:   Personal Maintenance Aid Keypad Layout

2.3   Aircraft Interface Panel Hardware

The AIP hardware platform will be a repackaged PMA with identical keypad and display. For the remainder of this document, all references to the PMA will be applicable to the AIP.

2.4   Maintenance Information Workstation Keyboard/Portable Maintenance Aid Keypad

The keyboard provides a basic set of key functions for:

- moving and selecting with the cursor

- entering alphanumeric characters (MIW) and numeric characters (MIW & PMA)

- displaying the menu bar

- accessing help

- turning on/off the display backlight (PMA)

Additionally, the keyboard contains a set of eight "soft-function keys" for situation-specific functions. These functions are available on the MIW and PMA hardware segments.

The functions required to interact with IMIS will be supplied by hard-function- and soft-function keys. Hard-function keys involve generic user interaction functions, such as data entry and cursor movement. The functions supplied by hard-function keys are more fully described in Section 2.4.2.

Soft-function keys invoke IMIS functions which are application-specific or specific to the current task the user is performing. Soft-function keys are more fully described in Section 2.4.3.

2.4.1 Keyboard Feedback

When a key is pressed, immediate (less than 0.1 second) visual feedback is provided on the screen to indicate that the key press was successfully registered. If the natural result of the key press provides immediate visual feedback (e.g., a pointer or cursor movement), no other feedback is necessary. If the result of the key press is not immediate, the pointer will change shape (i.e., a watch or hourglass) until the result occurs (see Section 4). If a currently inoperative key is pressed, there will be a visual indication that the key is inoperative.

If a keystroke which requires a new screen, is pressed, the screen will refresh immediately. If the response time to draw a new screen or complete a transaction is greater than five seconds, a progress indicator will be displayed in a pop-up window in the center of the current window (Salvendy, 1987). The progress indicator will dynamically change to indicate the amount of data transferred compared to the total amount which must be transferred. This information can be expressed textually (total percent transferred, e.g., 27%), graphically (a box which fills as the data is transferred), or both. The progress indicator will have, at a minimum, a function that will allow the user to cancel the transaction. When the new screen is ready for the display, the pop-up window will automatically disappear.

2.4.2 Hard-Function Keys

Of the 30 IMIS-specific keys on the MIW keyboard and PMA keypad, 22 keys will be available for use in most IMIS applications. These are the hard-function keys which

include: data-entry keys (a numeric keypad with period) and cursor-movement keys (arrow keys, TAB, BACKTAB, and DELETE). The MIW keyboard will also have alphanumeric keys in the traditional keyboard arrangement (Figure 2-1). Descriptions of the basic 22 hard-function keys appear in the following sections.

2.4.2.1 Arrow Keys

There will be four arrow keys, one for each of the four directions: up, down, left, and right. Pressing an arrow key will move the cursor in the direction indicated by that arrow key. Arrow keys are used for cursor movement within the current display screen.

The arrow keys will have an autorepeat capability; that is, if an arrow key is held down, the directional signal sent to the presentation system will be repeated every to be determined (TBD) seconds. Pointer movement is more fully described in Section 4 of this document.

Arrow keys are designated hard-function keys on both the PMA and MIW.

2.4.2.2 TAB Key

The TAB function, described in Section 4, will allow the user to move the cursor between fields (tab groups) on the screen. The TAB key is a designated hard-function key on both the PMA and MIW

2.4.2.3 BACKTAB Key

The BACKTAB function, described in Section 4, will allow the user to move the cursor to the previous Tab Group. The BACKTAB key is a designated hard-function key on the PMA and assigned to the [<shift> Tab] keys on the MIW.

2.4.2.4 SELECT Key

The SELECT key activates (or selects) the object at the current cursor location. These objects, for example, may be menu choices or text and graphics for which supplemental information is available. Object selection is discussed in more detail in Section 4. The SELECT key is a designated hard-function key on the PMA and will be assigned to the F9 key on the MIW.

2.4.2.5   Pointing Device

The pointing device will move the pointer around the display device. All pointing devices will have their own select function which will activate the object under the current pointer location. The pointer is discussed in Section 4.

On the PMA, a thumbknob will be used to move the pointer with a built-in select function. On the MIW, a mouse input device will be used for pointer movement and the left mouse button will be the pointer select key.

2.4.2.6   MENU Key

The MENU key is a push-button key that toggles the menu bar on/off. When pressed, it displays the menu bar and input focus is shifted to the menu bar. If the menu bar is on the screen when the MENU key is pressed, the menu bar will be removed and the input focus will return to the underlying application. The menu bar is described in Section 5.

The MENU key is a designated hard-function key on the PMA. On the MIW, a menu button will be available on the top left corner of the window border. Additionally, the menu function will be assigned to the F10 key on the MIW.

2.4.2.7   Number Keys and Decimal Point

There will be ten number keys for numeric data entry (0-9). Keys 1 through 9 will also be used to select menu items. There will also be a decimal point key (".") for entering numeric data.

2.4.2.8   DELETE Key

The DELETE key is used to remove individual characters while editing fill-ins. DELETE erases the character to the left of the cursor while in the insert mode, and erases the character under the input cursor while in the overstrike mode. DELETE will have an autorepeat capability and will be a designated hard-function key on both the PMA and MIW.

2.4.2.9 HELP Key

The HELP function displays on-line documentation which provides assistance for the task at hand (contextual help) and general system help. The description of HELP is TBD. The HELP Function is a designated hard-function key on the PMA and assigned to the F12 key on the MIW.

2.4.2.10 LIGHT Key

The LIGHT function will allow the user to toggle the PMA display backlight on and off. This function will not exist on the MIW.

2.4.3 Soft-Function Keys

There will be eight labeled keys on the keyboard which are known as the "soft-function keys." These keys will be used to present situation-specific functions and information to the user and will be reconfigured by the system depending on the current context. For example, they will be used for navigating the system, accessing information, interacting with dialog boxes, and performing other functions. As the user proceeds through various information displays, the functionality of these keys will change to match the situation. For example, when the user is viewing a troubleshooting screen, these keys will provide access to alternate diagnostic actions. In general, these keys will provide easy access to those functions and information that must be used to perform a specific task.

Functions assigned to the soft-function keys will have a consistent key assignment across all applications or modules. Additionally, functions with similar behavior but different labels (e.g., Back and Cancel) will share a common soft-function key assignment. The functions which will be supported by either soft-function keys or the menu bar are described below.

2.4.3.1 Next

The Next function moves the user forward through sequential information (presents the next section, module, step, paragraph, pane, etc., pertinent to the user's context). When the Next function is used, the state table internal to IMIS will be updated to indicate the logical unit which the user has completed. The user can move through a fixed sequence and complete a maintenance scenario by primarily using the Next function. This function will typically be assigned to the F1 key.

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2.4.3.2 Back

The Back function moves the backwards navigation through sequential information. It returns the user to the beginning of the previous unit of information (i.e., it does not retrace all the screens seen by the user) and will undo any changes made to the state table by the previous unit. The displays which the user will see when pressing Back will consist of logical units which were not the result of tangential actions by the user (e.g., accessing the menu bar or Help). The Back function will typically be assigned to the F7 key.

2.4.3.3 Cancel

The Cancel function closes the current dialog box or menu. In dialog boxes, the Cancel function resets all system variables to the state prior to entering the dialog box. The Cancel key will typically be assigned to the F7 key.

2.4.3.4 Return

The Return function will be used when the user transfers to a new thread of information and wishes to return to the previous thread. Return will take the user back to the point at which the previous thread had been left (e.g., in TO Presentation, when the user goes from a procedure step to Theory of Operations and returns to the procedure).

When the user invokes Return while in a process that would change the state table, the state table in IMIS will be returned to its original state (prior to entering the current thread of information). In this use of Return, the user is presented with a dialog box containing a statement to the effect that using Return will "undo" all previous work, and will prompt the user for acknowledgement before proceeding. Return will be inactive during the display of procedural information. The Return key will typically be assigned to the F8 key.

2.4.3.5 Quit

The Quit function allows the user to leave an application. Invoking Quit indicates to the system that the user has completed the session or finished using the application. The system will give the user the opportunity to save data unless it has already been saved by the system. The Quit function will be available through the menu bar.

2.4.3.6   Home

The Home function returns a scrolled image to its original state after scrolling has occurred. Home will only be available after scrolling has occurred. The Home function will typically be assigned to the F5 key.

2.4.3.7   Supp Info

The Supp Info function toggles on and off the highlighting of every item on the screen with links to supplemental information (theory, parts, etc.). The Supp Info function will only be displayed when data on the current screen has links. Use of the Supp Info function is described in Section 4. The Supp Info function will be assigned to the F4 key.

2.4.3.8   Keyboard

The Keyboard option displays a simulated keyboard for alphanumeric entry. The keyboard function is described in Section 4.

2.4.3.9   Options

The Options function displays a list of items from which the user can select to enter into a fill-in. The Option function is described in Section 4.

2.4.3.10   Pointer/Cursor Setup

The Pointer Mode function will allow the user to adjust the behavior of the pointer on the MIW or PMA. The Pointer Mode function, described in Section 4, will be available through the menu bar.

2.5   System Response Times

IMIS will support the response times appearing in Table 2-1 (DoD, 1989).

Table 2-1: Integrated Maintenance Information System Response Times

System Interaction	Response Time Definition	Maximum Acceptable Time (Secs)
Key Response	Key depression until positive response (e.g., "click")	0.1
Frame Advance	From end of request until first few lines are visible	1.0
XY Entry	From selection of field until visual verification	0.2
Function	From selection of command until response	2.0
Simple Update	Change to simple image (e.g., new menu list)	0.5
Complex Update	Change to complex image (e.g., a scale change of existing image)	2.0
Inquiry (Simple)	From command until display of a commonly used message	2.0
Inquiry (Complex)	Response message requires seldom-used calculations in graphic form	10.0
Error Feedback	From entry of input until error message appears	2.0

3. IMIS DISPLAY SCREEN

The display screen for the PMA and each open window on the MIW will be divided into five regions: Header, Content (which is subdivided into different types of data panes [see Section 7]), Message Line, Icon, and Function Key Label Regions. See Figure 3-1 for screen region layout.
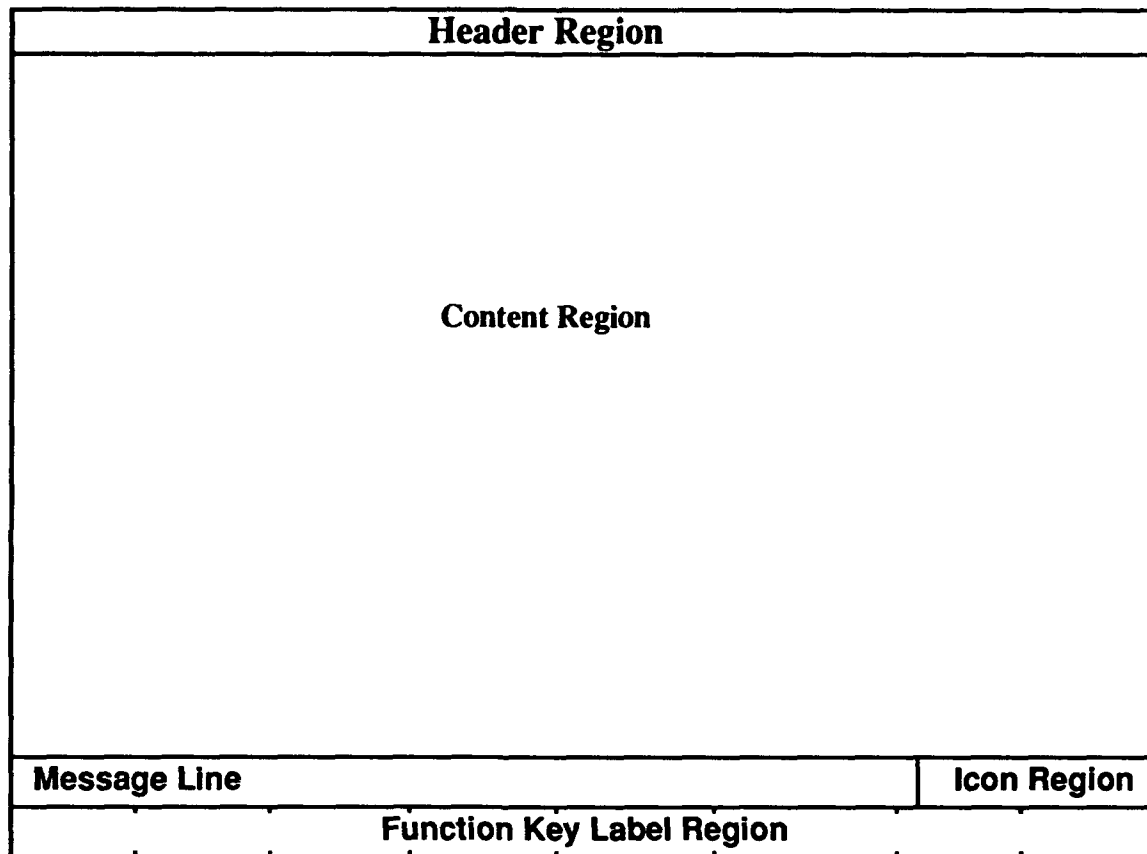
Figure 3-1: Screen Region Layout

3.1 Header Region

The Header Region (a box across the top of the screen) contains a title bar or, alternately, a menu bar. The Header Region will be visually separated from the Content Region and will normally display the title bar, except when the menu bar is active.

3.1.1 Title Bar

The title bar contains a one-line title describing the information displayed in the content region. The title will be centered (to aid in creating symmetry) and displayed in all caps in the title font. For example, when TO information is presented, the title bar will contain the title of the displayed TO task.

3.1.2 Menu Bar

The menu bar, when visible, consists of a maximum of nine numbered menu titles, representing nine pull-down menus which give the user access to all IMIS functional areas. Menu-display characteristics are described in Section 5.

3.2 Content Region

The Content Region, or screen body, contains the text, graphics, tables, prompts, and dialog boxes which constitute the information content of the screen. The rules for displaying these contents are discussed in detail in Sections 6 and 7. All text which appears in the Content Region will appear in either the normal, title, or system font. (For additional information on display of text see Section 7.)

3.3 Message Line

The Message Line is reserved for instructional messages to the user. The content of these messages ranges from how to proceed through the application to informational messages regarding the current state of the system or the result of an action taken by the system. Text in this area will be left justified, mixed case, and displayed in the system font. Descriptions of exact messages will be specified in each application description.

3.4 Icon Region

The Icon Region will be located to the right of the Message Line (see Figure 3-1). This region will display icons which will convey visual cues about the current state of the system. Only one icon of each currently active type will be displayed. If the user selects an icon, all messages pertaining to that type of icon will be displayed (selection of icons is discussed in Section 4). Icons will be displayed in this region in a consistent location throughout all IMIS applications. Table 3-1 contains a description of each icon and illustrates the order in which icons will appear in the icon area.

Table 3-1:   Integrated Maintenance Information System Icons

⚠	Warning	Indicates TO warning is in effect for the current maintenance action.
◇	Caution	Indicates TO caution is in effect for the current maintenance action.
📑	Note	Indicates TO note is in effect for the current maintenance action.
M	Memo	Indicates that the user has generated a memo attached to the current step/information displayed.
📖	Bookmark	Indicates that the current step/information on the screen has been bookmarked.
C	Change	Indicates that a change has been made to the current step/information.
⏱	Stopwatch	Indicates that the stopwatch is running and counting the elapsed time of the current application or task.

3.5   Software-Generated Function Key Labels

The software-controlled function key labels appear at the bottom of the screen. These labels correspond to the function keys on the hardware devices. Each key label will be visually distinct from the adjacent function key labels. On the MIW, the function key labels are selectable by the mouse or function keys (F1 through F8) on the workstation keyboard. On the PMA, the functions will be selectable via the function keys located directly below each label. The font size to be used, the allowable number of characters per label, and abbreviation/truncation rules will be determined through prototyping. The functionality of the function keys are reassigned depending upon the application being performed. Specific reassignment of the keys is discussed in the appropriate sections.

3.6 Management Information Workstation and Portable Maintenance Aid Display Differences

The interaction style of any application running on either the PMA or MIW will be the same. However, IMIS applications running on the MIW will be optimized to take advantage of the large screen display and mouse input device. Other differences between the PMA and MIW will be determined as required to optimize the UI for each device while maintaining a consistent UI among hardware platforms.

The major differences between the MIW and PMA are soft-function key label selection, menu bar activity, and the ability to have multiple windows open simultaneously.

On the PMA, the soft-function keys are mapped to function keys F1 through F8. To reduce the number of selectable items on the screen, these labels will not be accessible with the pointer/cursor. On the MIW, these functions will be selectable via the pointer.

Another potential difference between PMA and MIW is menu bar activity. The application window on the MIW should be made large enough to support both a menu bar and title in the header region simultaneously. The menu bar on the MIW should be located in the line directly above the header region so that both the menu bar and application can be active at the same time.

Unlike the PMA, the MIW will support multiple applications running concurrently. Each window on the MIW will be opened to a default size based on the IMIS application. The windows will have a border (that highlights when active) and a title that will not appear on the PMA. The windows will have the ability to overlap, with the active window displayed on top. The user will be able to close a window, resize a window, and change the location of a window on the screen as described in the Motif Style Guide (Open Software Foundation, 1991).

4. POINTER/CURSOR MOVEMENT AND SELECTION

All IMIS applications will be designed to support user control via the keyboard, a pointing device, or both. The intent is to design applications that provide users a choice of input devices so they may choose the input style that suits their needs. Within this framework, users will be able to use the keyboard or a pointing device to position the input focus to any portion of an application.

The pointing device provides a basic "point and click" capability which enables the user to move to (or point at) and select (click) items in an application. The pointer is a physical representation of the pointing device location in the application. The cursor provides an alternative way to point and click (without a pointing device) by using the arrow keys on the keyboard. The cursor is a physical representation of where the keyboard is focused in the application.

In addition to the navigation functions described earlier in this document, users may interact with an application by changing input focus (via the arrow keys or pointing device) and activating selectable items on the display device. Selectable items are objects on the screen that perform an action when activated (selected). They allow the user to converse with and request information from an application. Examples of selectable items are menu items, checkboxes, and linked text and graphics. The user has three different ways to make item selections; these are as follows.

- The user may position the pointer over the item of interest using the pointing device, then press and release the pointer select button to activate the item.

- The user may position the cursor over the item of interest using TAB functions and/or the arrow keys, then use the SELECT function to activate the item.

- If the item of interest is associated with a number or function key, the user can select the item by pressing the associated key.

This selection capability will be used for a variety of purposes. For example, the user would have the option to:

- select a menu item to "pop up" a submenu of choices,

- click on a check box to record a completed maintenance action,

- select a word to read its glossary definition,

- select a subsystem from the system-subsystem-subassembly hierarchy,

- click on a graphic call-out to access information related to the depicted part,

- select a component in a block diagram to display a more detailed subdiagram, or

- click on a warning icon to review the related warning message.

A description of pointer and cursor behavior is contained in the following sections.

4.1   The Pointer

The pointer on both the PMA and MIW will be used to select items such as menu choices and selectable objects on the screen. The pointer will be a black arrow with a white border as shown in Table 4-1. The white border will keep the pointer from "disappearing" when positioned over black objects. The user may move the pointer by using a pointing device (mouse on the MIW and thumbknob on the PMA).

Table 4-1:   Pointer Shapes

Pointer	Input Pointer	Waiting Pointer

The pointer will change shape to provide a visual indication of different situations to the user. The pointer will change into an input pointer when positioned over a text entry area such as a fill-in. Additionally, the pointer will change into a waiting pointer (see Table 4-1) when the system is busy processing.

4.1.1 Moving the Pointer

The pointer is moved across the screen with the pointing device. On the MIW, moving the mouse across a surface causes the pointer to move a set number of pixels across the screen in the direction the mouse is being moved. Similarly, the thumbknob on

the PMA will move the pointer a set number of pixels across the screen in the direction the thumbknob is being pressed.

A pointing device allows rapid movement of the pointer to any region of the screen. The user will move the pointer to the item of interest, then select the item by pressing and releasing the pointer select function (left mouse button on the mouse or select function on the thumbknob).

In the PMA or within a window of the MIW, the user can move the pointer anywhere on the screen and select an object. For the MIW only, IMIS may have several applications opened in several overlapping windows. The user can switch between multiple IMIS windows by moving the pointer from one window into a different window, then pressing and releasing the pointer select button. This will activate the new region and shift the keyboard focus to the selected window.

The user can move the pointer by one of two means: dragging the pointing device or clicking the pointing device. The nature of the selection process for the pointer is different in both modes.

4.1.1.1   Dragging the Pointing Device

Dragging the pointing device requires the user to press and hold down the pointer select button while moving the pointer. When dragging the mouse within a menu, selectable items will highlight (i.e., turn reverse video) as the pointer passes over them. If the tip of the pointer moves within the boundary of a selectable region, that region will highlight. If the user releases the mouse button while over a selectable item, that item will activate. If the pointer moves outside the boundary of a highlighted region while dragging, that region will de-highlight.

4.1.1.2   Clicking the Pointing Device

Clicking the pointing device requires the user to place the pointer over the selectable item of interest, then press and release the pointer select button. When clicking the pointer, selectable items will highlight (invert) as the pointer device button is pressed and activate when the button is released. If the user moves the pointer off a selectable item while the pointer select button is depressed, the item will de-highlight and the activation will be nullified.

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4.1.2 Pointer Stability

The default location for the pointer will be the middle of the display device. The pointer will remain in the same screen coordinate location unless the user intentionally moves the pointer, at which time the pointer will move as indicated by the movement chosen.

4.2   The Cursor

Both the PMA and MIW cursors will be used to select items such as menu choices and selectable objects on the screen. The cursor identifies the area or item on the screen where the keyboard is focused. In most cases, the user will move the cursor by using the arrow keys or the pointer. If selectable items are labeled with numbers or function key labels, the number or function keys may move the cursor.

4.2.1 Cursor Shapes

The cursor highlights (outlines) the selectable item on which it rests. The shape of the cursor changes with the type of selectable item. For example, when using a menu, the cursor highlights one menu item at a time. In this instance, the cursor is the same shape as a menu item (a box) as shown in Table 4-2.

Table 4-2:   Cursor Shapes

Cursor	Input Cursor (insert)	Input Cursor (overstrike)
▭	|	▮

When the keyboard is focused on a fill-in or other text entry area, the cursor changes into an input-cursor shape. The input cursor will be presented to mark the screen location for the next entry. The shape of the input cursor will be a vertical bar (during insert mode) or an inverted box (during overstrike mode) as shown in Table 4-2.

4.2.2 Moving the Cursor

The arrow keys will move the cursor from one selectable object to another, or "leap" between selectable objects.

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There are four arrow keys which move the cursor up, down, left, or right. Each arrow action causes the cursor to "leap," or jump, from its current location to the nearest selectable item in the direction of the arrow key being depressed.

4.2.2.1 Leaping Between Aligned Areas

When selectable areas are aligned, whether vertically and/or horizontally, pressing the arrow key will cause the cursor to leap to the nearest selectable item in the direction of the arrow key being depressed (see Figure 4-1). When the cursor reaches the selectable item closest to the edge of the active screen region, additional presses of the arrow key will not cause the cursor to move any further (i.e., the cursor will not "wrap around" to the other side of the active screen region).
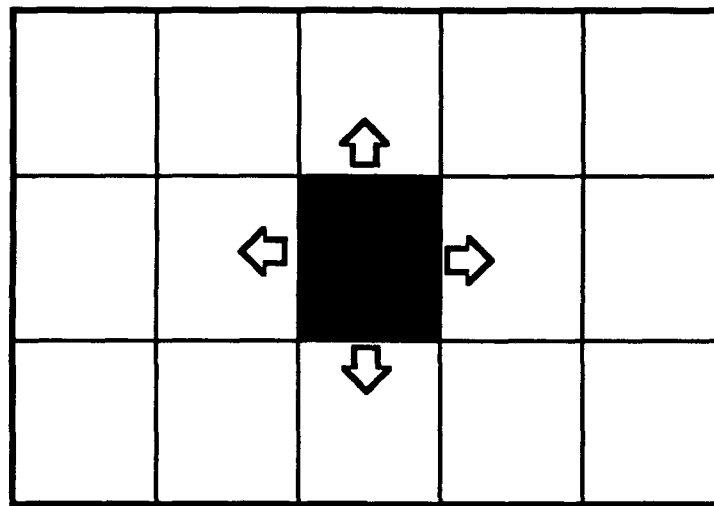
Figure 4-1: Cursor Movement Between Aligned Items

4.2.2.2 Leaping Between Nonaligned Adjacent Areas

The following rules govern leaping between nonaligned adjacent areas on the display screen (see Figure 4-2).

Up Arrow: Move the cursor to the selection item left and directly above the currently highlighted selection item.

Down Arrow: Move the cursor to the selection item left and directly below the currently highlighted selection item.

Right Arrow: Move the cursor to the top selection item directly to the right of the currently highlighted selection item.

Left Arrow: Move the cursor to the top selection item directly to the left of the currently highlighted selection item.
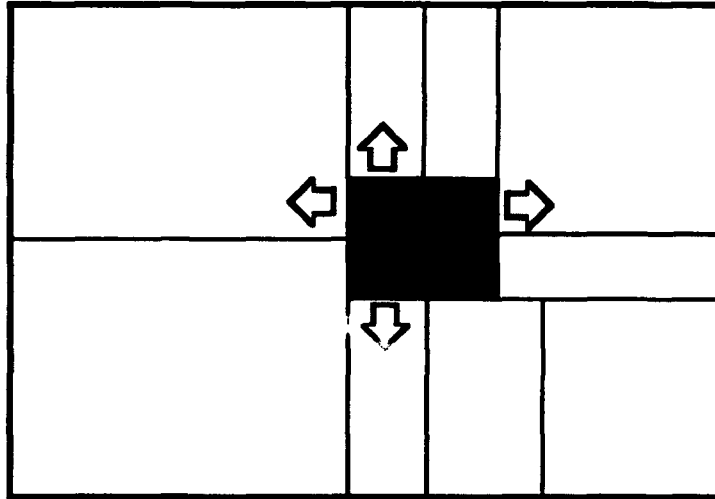
Figure 4-2: Cursor Movement Between Nonaligned Adjacent Items

4.2.2.3   Leaping Between Nonaligned Nonadjacent Areas

Leaping within a region of nonadjacent items could result in a situation like that shown in Figure 4-3. In the case where regions are not adjacent, a specialized cursor movement method will be used to move from one selectable region to the other. As shown in the diagram, the upper-left-hand corner of the selectable region will be used as the anchor point from which the tabbing algorithm will work. Two cursor movement schemes will be used for each display: a horizontal and a vertical method.
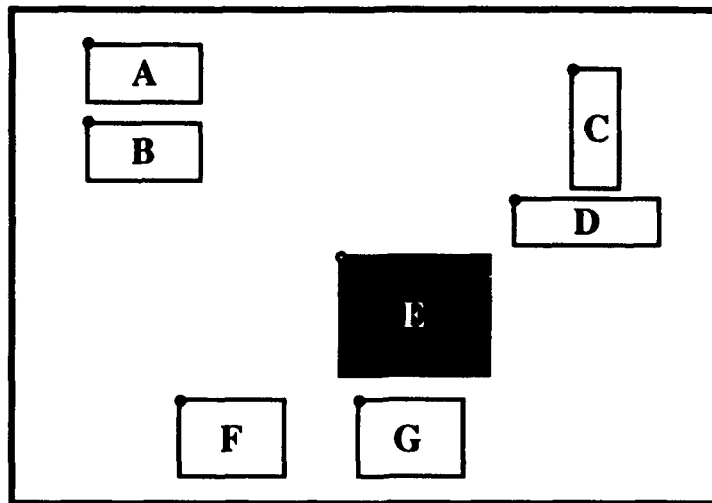
Figure 4-3: Cursor Movement Between Nonaligned Nonadjacent Items

The horizontal cursor movement scheme will assign an order to all selectable regions on the display based on the anchor point. The order will assign the regions moving pixel-by-pixel horizontally across the display, wrapping down to the next line, and again moving horizontally across the display until the bottom-right corner of the display is reached. The left and right arrow keys will move the cursor in the horizontal direction. For example, in Figure 4-3, continually pressing the right arrow from region A would move the cursor to C, then B, then D, then E, then F, then G. Continually pressing the left arrow key from G would result in movement opposite from the one just described (i.e., G, F, E, D, B, C, A).

The vertical cursor movement scheme will assign an order to all selectable regions on the display based on the anchor point. The order will assign the regions moving pixel-by-pixel vertically down the display, wrapping up to the next column, and again moving vertically down the display until the bottom-right corner of the display is reached. The up and down arrow keys will move the cursor in the vertical direction. For example, in Figure 4-3, continually pressing the down arrow from region A would move the cursor to B, then F, then E, then G, then D, then C. Continually pressing the up arrow key from region C would result in movement opposite from the one just described (i.e., C, D, G, E, F, B, A).

Some obvious deficiencies exist with this method (especially in relation to intuitive movements of the cursor); however, this method does assure that the user can reach every

available selectable region on the display (which is a problem with many of the alternative methods).

4.2.2.4 Moving the Cursor via the Pointing Device

As indicated earlier, the user may use the keyboard (arrow keys and Select) or the pointing device (mouse and left button or thumbknob and thumbknob button) to interact with an application. Primarily, the keyboard controls the cursor and the pointing device controls the pointer. The user cannot move the pointer with the arrow keys. However, the pointing device can move the cursor by simply clicking the pointer on a selectable item. For example, the pointer can be used to move the cursor from the beginning to the end of a text string by placing the pointer at the end of the text string and clicking the left mouse button. Another example is that when dragging the pointer in a menu, the user is essentially dragging the cursor with the pointer. Detailed pointer/cursor behavior for all user interface components is described in the appropriate sections.

The user may use the pointer to switch input focus between screen regions (tab groups) or between concurrent applications (windows). By placing the pointer on another screen region and clicking the pointer select button, the system will switch keyboard focus to that region or window.

If the pointer were placed on top of a selectable item in the new region within the current window, that item would activate. If the pointer were not placed on a selectable item within the current window, the cursor would move to the upper-left-most selectable item in the new region.

If the pointer were placed on top of a selectable item in another window, the cursor would be placed on top of that item. To activate the item, the user must press the select key or the pointer select function. If the pointer is placed within a tab group (see Section 4.3 for an explanation of tab groups) and is not on a selectable item, the cursor will move to the upper-left-most selectable item in the tab group of the new window. If the pointer is not placed within a tab group of the new window, the cursor will move to the upper-left-most selectable item in the upper-left-most tab group of that window.

4.2.2.5 Moving the Cursor via the Function or Number Keys

Another way to move the cursor is to press the number or function key associated with a selectable item on the display screen. This will cause the cursor to move to the

selectable item and activate it. After the item is activated, the cursor will either move into another modal window linked to the selectable item or remain on the selectable item.

4.2.3 Cursor Stability

The cursor will remain on the same screen location unless one of the following situations occurs:

- the user intentionally moves the cursor, at which time the cursor will move as indicated by the movement chosen; and/or

- a dialog box, pop-up menu, or other modal "window" is invoked by the system or the user, at which time the cursor will move into the upper left-most selectable region of that window. If there are no active selectable areas in a window, the cursor will not appear in that window.

When switching between applications and back again, the cursor will return to its location in the previous window or application.

4.2.4 Selecting Items with the Cursor

The user has two ways to use the keyboard (or keypad) to select items on the display: using the select function or using the number/function keys. These selection techniques are described in the following sections.

4.2.4.1   Selecting an Item via the SELECT Function

Once the user has highlighted the item of interest, he/she may select the item by pressing the SELECT function. The SELECT function will be a dedicated SELECT key on the PMA keypad and the F9 key on the MIW keyboard. The highlighted region will acknowledge the keystroke and respond to the activation. The nature of the item's response depends on the nature of the item. For example, if the item is a menu action, that action will be executed; if the item is a check box, the box will be checked; and, if the item is a selectable word, the associated links of that word will be displayed in a menu.

4.2.4.2 Selecting an Item via the Number or Function Keys

If the item of interest is associated with either a number or function key, the user can select the item by pressing the associated number or function key. In this method, the user does not have to press the SELECT key.

To make selections via the number keys, numbers must be associated with the selections. Menu items and choices in a dialog box may be numbered. Graphic components in a diagram may be numbered, such as within a troubleshooting block diagram.

Groups of numbered selections must never contain more than nine items. Whenever an active selection is numbered, the user may use the number keys to select that item. Whenever an active selection is not numbered, the user must use the arrow keys or pointing device to select the item.

4.3 Tab Groups

At any time, an IMIS application or window may contain many selectable items. To eliminate haphazard cursor movement associated with numerous selectable items on the screen, windows will be broken into fields of related selectable items called "tab groups." Tab groups allow for sequential interaction with the data (Open Software Foundation, 1991).

Cursor movement will be constrained to selectable items within a tab group. The user will use the pointer or cursor to move between selectable items within a tab group. The TAB function provides an explicit action for the completion of an interaction with a tab group and shifts keyboard focus to the next tab group (i.e., the user will make input into the presentation system and press the TAB function to move to the next field). Potential tab groups are: individual data panes within the content region, scroll bars, the icon area, fill-ins, choice lists, and menus (see Section 6 for an example of tab group interaction).

4.3.1 Moving Between Tab Groups

The user will interact with items in another tab group by Tabbing to that field or using the pointer. The user can change tab groups by placing the pointer in a screen region (other than the active screen region) and clicking. Keyboard focus will shift to the new tab group and the cursor will move into that tab group.

The TAB and BACKTAB functions allow the user to move the keyboard focus between tab groups. TAB moves the cursor to the next field and BACKTAB moves the cursor to the previous field. Repeated key presses will cycle the user through the tab groups in the active window. When engaging TAB and BACKTAB, the system will not acknowledge a tab group that does not have selectable items.

When moving between tab groups, the cursor will be positioned on the upper-left-most selectable item within the tab group (except for fill-ins). Tabbing will occur in a left-to-right and top-to-bottom fashion. Repeating the TAB function will cycle the input focus through all the tab groups in the active window. For example, if there are multiple rows of tab groups, the input focus will shift across the first row until the right-most item is reached. Further tabs will wrap the input focus to the left-most item in the second row and eventually across to the right-most field in the second row. This process will continue until the last tab group is reached (the bottom-right corner of the active window). Pressing TAB from the last group will return the keyboard focus to the original (top-left-most) tab group.

The user cannot use the TAB function to leave modal windows such as dialogs or menus; he/she must make some input to the dialog or menu before moving the cursor to another screen region. Some windows within an application, such as dialog boxes, may have selectable items sectioned into tab groups. Each user interface component has a description of pointer/cursor movement and tab groups.

4.3.2 Display Characteristics of Tab Groups

The active tab group will be distinguished from the other tab groups by giving the appearance of being raised in a three-dimensional (3D) environment (color or grey-scale) or outlined in a two-dimensional (2D) (monochrome) environment.

4.3.3 Default Tab Groups

Each information type in IMIS will have a default tab group. This is the screen region that will have keyboard focus when the application is initially displayed. Normally, the default tab group will be the upper-left-most tab group in the window. The user will remain in the default tab group unless he/she intentionally switches to another. The default tab group is often the screen region that requires the most user interaction.

4.4 Supplemental Information

To reduce the number of selectable items on the screen at any given time, only those items which are required to perform the primary task are selectable (e.g., menu choices, fill-ins, options in a prompt, items in a dialog box, call-outs of a graphic, icons, etc.). However, the data which supports maintenance may have links to additional or supplemental information. For example, a graphic component in a technical manual may have data base links to parts information or theory of operation. There can be supplemental information associated with any IMIS application.

Supplemental information is information or data which is linked to the information currently on the screen and used by the user to support his/her performance of the primary task. Supplemental information is supportive of the primary task and information used in task performance.

The user may choose to view the items in the current window with supplemental information by engaging the Supp Info function. When Supp Info is engaged, only those items to which cross-referenced or additional information is linked are selectable. The Supp Info function toggles on/off the activation of items with supplemental information.

Different aspects or applications of IMIS will have different types of supplemental information available. For example, during the presentation of TO procedures, supplemental information may be linked to text and/or graphics such as Theory of Operation, schematics, Illustrated Parts Breakdowns (IPBs), and other information available to support the user while performing the current maintenance task.

There may also be supplemental information available which will provide help. The categories of supplemental information associated with system messages may include, but are not limited to, an explanation of the message, directions on how to respond to the message, and examples of such responses. Labels for fill-in fields, table headers, and row labels will have supplemental information which will include an explanation of the contents of the field, directions for determining the contents, the format of the contents, and examples of the contents.

4.4.1 Display Characteristics of Supplemental Information Items

When the Supp Info function is engaged, the bounding perimeter of each item in the active window for which there is supplemental information will become visible and selectable. Both text and graphic items will be denoted by making the bounding perimeter visible. The bounding perimeter of selectable text and graphic call-outs will make the selectable area visually distinct. For text, the bounding perimeter will surround the selectable word(s). For graphics, the bounding perimeter will surround the graphic component or the call-out pointing to the selectable graphic (see Figure 4-4).
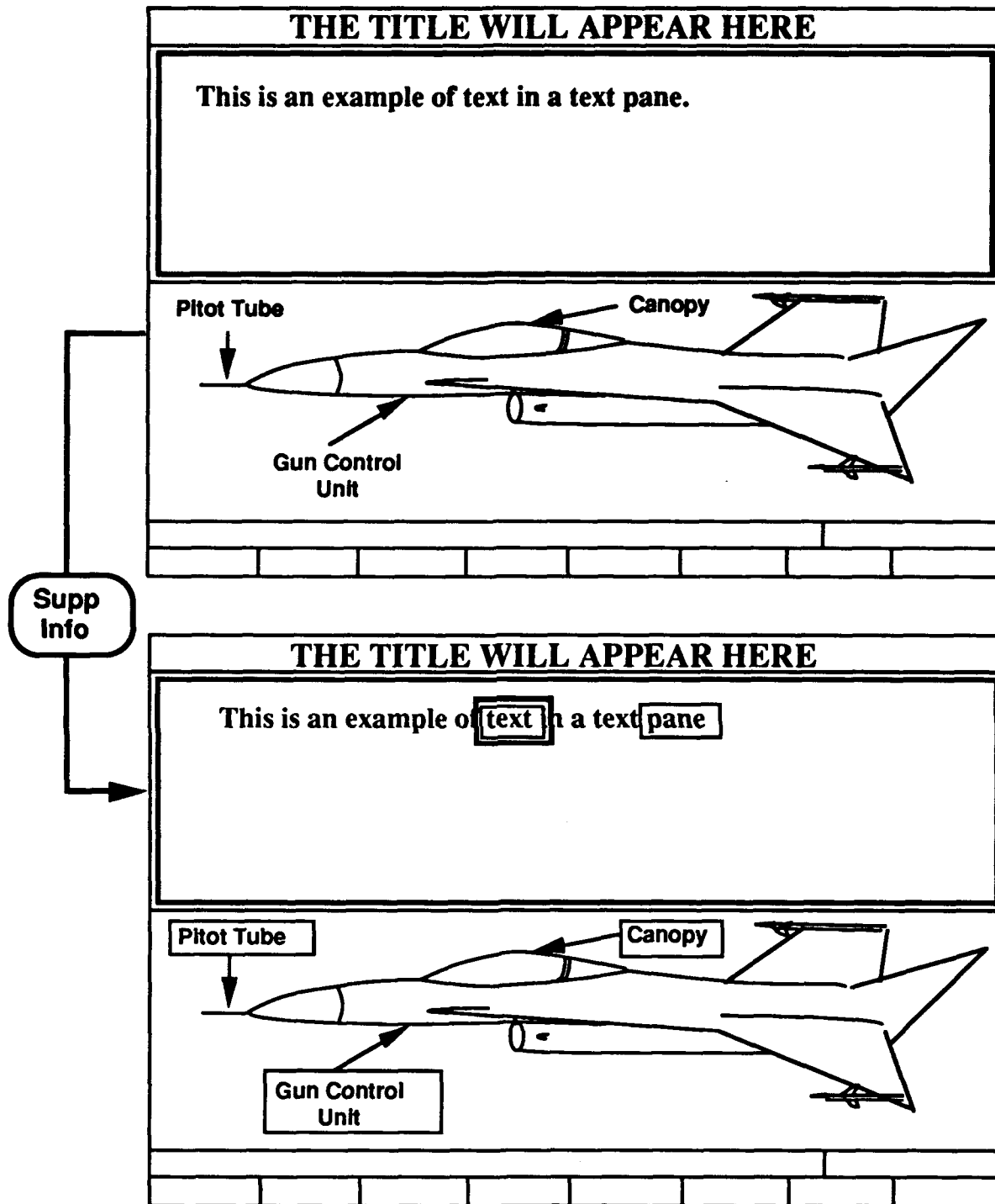
Figure 4-4: Supplemental Information in Text and Graphics Panes

For tables, the Supp Info function will cause a rectangular box to appear within each selectable cell, bounding the contents of the cell (see Figure 4-5). When Supp Info is

engaged, the cursor will move to the top-left-most selectable item within the current tab group.

Part Number	Reference Designation	Name	Description
A123 569	DBT90	Dead Bolt	Used all over aircraft

SUPP INFO

Part Number	Reference Designation	Name	Description
A123 569	DBT90	Dead Bolt	Used all over aircraft
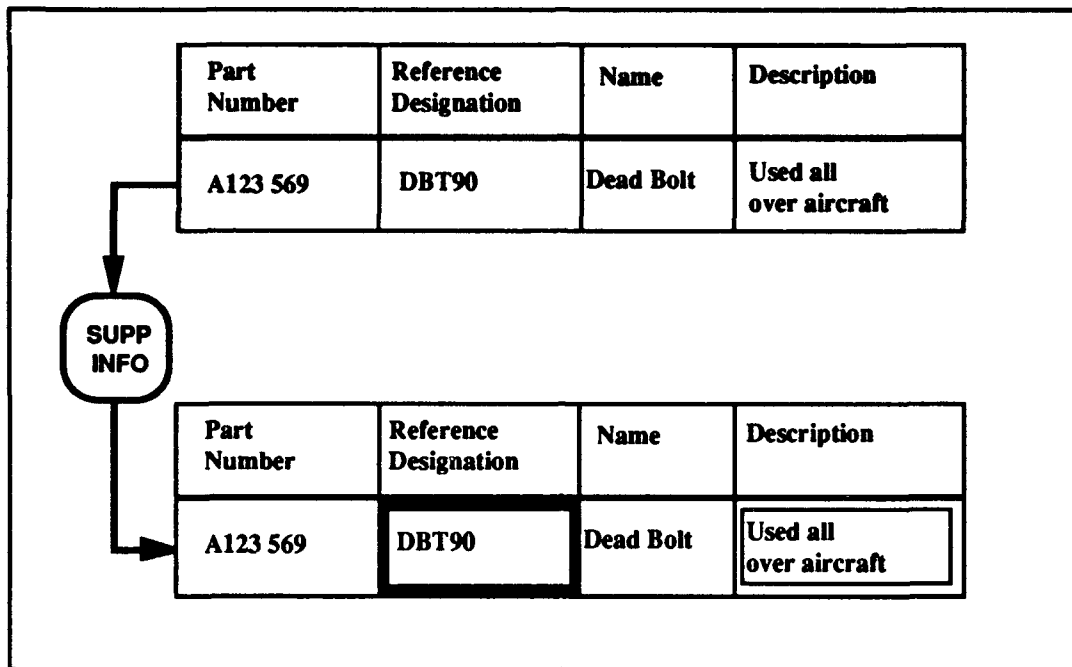
Figure 4-5:   Supplemental Information Within a Table

4.4.2 Pointer and Cursor Movement with Supplemental Information Items

When the Supp Info function is engaged, the items with supplemental information within the content region will be delineated. Only those items in the active tab group will become selectable. Any items which were selectable to perform the primary task will be inactive. Cursor movement via the arrow keys will be constrained to those selectable items within the active tab group. The user must activate the TAB function or use the pointer to select supplemental information from another screen region.

4.4.3 Selection of Supplemental Information Items

The selection of supplemental information items can be performed in two ways: highlighting the item with the cursor and pressing select or clicking the pointing device on the item.

When an item with supplemental information is selected by the user, a pop-up menu (see Section 5.4) will appear that lists all the available supplemental information types for

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that item. After the user selects the desired information type from the menu, the system will display the associated information.

4.4.4 Returning to Primary Information

After the user has reviewed the supplemental information, he/she will be returned to the display of primary information from which the supplemental information was accessed. If the user accesses a supplemental information selection and reviews it in its entirety, using the NEXT function at the completion of the review will return the user to the primary information mode. If the user does not review all the data supplied by a supplemental information selection, he/she will use the RETURN function to go back to the screen from which the supplemental information mode was accessed. In this case, the cursor will either rest on the upper-left-most primary information item or not be displayed (if no selectable items exist), and the Supp Info function will be deactivated.

4.5   Pointer/Cursor Setup

The Menu Bar will contain an option for "Pointer Setup." If this option is selected a Pointer Setup dialog box will be presented which contains entries for the user to set the following parameters.

- The pixel distance for image movement while scrolling can be selected (e.g., one pixel, ten pixels, or fifty pixels at a time).

- Turbo speed can be on or off. Both the arrow keys and the thumbknob on the PMA will have a "turbo" movement facility. That is, the speed of cursor and pointer movement will increase with the length of time the key is depressed.

5. MENUS

There are three types of menus: the Menu Bar, pull-down menus, and pop-up menus. Once the user accesses the Menu Bar, various functions are available through pull-down menus. Pop-up menus provide the user with context-specific access to information that will help in performing the assigned tasks (e.g., TO presentation, opening work orders, scheduling, etc.).

The purpose of the menu system is to allow users to branch off the pre-established path through IMIS so they can take certain actions or access specific information in support of the overall task. That is, a menu allows the user to perform actions such as opening work orders, reviewing aircraft status, calling up utility programs, accessing supplemental information associated with a selected item, accessing help, etc. The Menu Bar and pull-down menus will allow access to overall system information, utilities, and application-specific aids, or will allow a review of various types of information. These accessing schemes will be available through activation of the Menu Bar.

Pop-up menus are similar to pull-down menus but are used for different purposes. For example, pop-up menus may contain a list of supplemental information linked to a selectable item or a list of items to enter into a fill-in (e.g., filling in work unit codes). The contents of pop-up menus are driven by the selected item and the information linked to that selection.

5.1 Hierarchical Selections

Hierarchical selections consist of selectable items which have been organized into a multiple-level structure. Figure 5-1 illustrates two different views of the same hierarchical structure. First is the cascading view in which levels of the hierarchy are represented by layers of cascading regions. Menus are typically arranged in a cascading view. Second is an outline view in which levels of the hierarchy are represented by indentation. List boxes are a variation of menus and are typically displayed in the outline view (see Section 6.2.3 for a description of list boxes). Note that the numbering system used in Figure 5-1 is for explanation purposes and is not meant to be used as a guideline for numbering hierarchical selections.

```
┌─────────────────────────────────────────────────────────────┐
│  Cascading View                      Outline View           │
│                                                             │
│  ┌──────────┐                      ┌──────────────────────┐ │
│  │1. Top Item│                     │1. Top Item           │ │
│  └┬─────────┴──────┐               │  1.1. Subitem 1      │ │
│   │1.1. Subitem 1  │               │    1.1.1. Sub-subitem│ │
│   │1.2. Subitem 2  │               │    1.1.2. Sub-subitem│ │
│   │1.3. Subitem 3  ┌────────┐      │    1.1.3. Sub-subitem│ │
│   └────────────────│1.3.1.  │      │  1.2. Subitem 2      │ │
│                    │1.3.2.  │      │  1.3. Subitem 3      │ │
│                    └────────┘      │    1.3.1. Sub-subitem│ │
│                                    │    1.3.2. Sub-subitem│ │
│                                    └──────────────────────┘ │
└─────────────────────────────────────────────────────────────┘
```
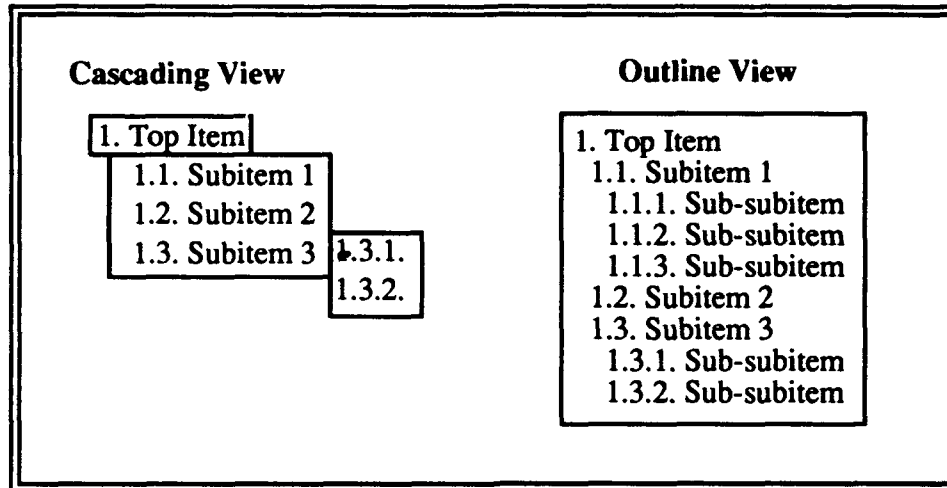
Figure 5-1: Views of a Typical Hierarchy

5.2   Menu Bar

The Menu Bar provides the primary area of access for IMIS system functions. The Menu Bar and pull-down menus are used together to provide the user with overall system access. Menus on the Menu Bar are used to select options that remain constant in the system.

In the PMA, the Menu Bar will not be visible to the user. To display the Menu Bar, the user must activate the MENU function. The MENU function will toggle the Menu Bar on and off. When the MENU function is activated, the Menu Bar will be displayed across the top of the screen where the Title Bar is usually located. When displayed, the input focus will be on the Menu Bar. The Menu Bar cannot be accessed when the user is within a dialog box.

For the MIW, the MENU function can be activated by selecting the window menu button (on the top-left corner of the window border) or by pressing the menu function key on the keyboard. The menu will be displayed on a line above the header region. The user can interact with the application while the menu is displayed. In this case, the Menu Bar will be in a separate tab group.

To deactivate the Menu Bar, the user will have to either execute a menu item, press Cancel, or use the MENU function. When the Menu Bar is deactivated, the Title Bar will be displayed and the cursor will be located on the upper-left-most selectable item of the content region or the cursor parking region (if no selectable items exist).

5.2.1 Display Presentation of the Menu Bar

The Menu Bar will consist of a maximum of nine Menu Bar regions and each region (i.e., selectable area) will be assigned a title. All pull-down menus on the Menu Bar will have nine or fewer items. Menu Bar regions will be evenly spaced horizontally across the top of the screen with a maximum of two lines. Menu Bar titles will be used to identify the function of that selectable region to the user. Each Menu Bar title will be numbered consecutively from one to nine starting on the left side of the screen (see Figure 5-2). Each number will be followed by a period, one space, and the menu name. Menu names shall be a descriptive label, with the initial character uppercased, that clearly differentiates that title from other titles in the Menu Bar as well as from other menu items in the menu system.

The Menu Bar regions will be visually distinct from the Content Region. Each menu title will be centered top-to-bottom within the Menu Bar and will be left justified within the Menu Bar Region provided for that title.

5.2.2 Menu Bar Contents

The specific contents of the Menu Bar will be determined by the specific application that is currently running on the system. Menu Bar contents are documented in the user interface description of each application.

5.2.3 Pointer/Cursor Movement and Selection within the Menu Bar

The following sections describe the details of pointer/cursor movement and selection within the Menu Bar system.

5.2.3.1   Pointer Movement and Selection in the Menu Bar

The user can interact with the Menu Bar by either dragging the pointer or clicking the pointer (see Section 4 for a description of dragging and clicking the pointer).

When dragging the pointing device, the user will be able to "pull down" menus from the Menu Bar. Menu items will be highlighted as the pointer passes within their boundaries. For example, the user can drag the pointer across the Menu Bar to the desired title. Once on the desired title, the user can drag the pointer downward onto the pull-down menu without releasing the mouse button. If the pull-down menu contains any submenus, these can also be accessed for selection without releasing the mouse button. In this mode,

the menu items are not executed until the pointer select button is released. If the user drags the pointer off a pull-down menu (or its submenu), the menu will remain displayed.

Once a menu and/or submenu is activated by the dragging method, the user can only respond to menu items in that hierarchy (this includes parent menus). The user can cancel the menu or submenu when dragging by: (1) releasing the pointer select button with the pointer positioned off the menu (at which time all menus will cancel) or; (2) moving the pointer over another parent item in the parent menu (at which time its associated submenu will be displayed).

When clicking the pointing device, the Menu Bar will respond the same as when using the arrow keys and cursor (see below). As the user passes the pointer over the Menu Bar items, the cursor will remain in its current location (i.e., Menu Bar items will not be highlighted). When the user depresses the pointer select button on a Menu Bar item, the item will be highlighted and the associated pull-down menu will be displayed. After releasing the pointer select button, the cursor will move to the first item in the pull-down menu. The user will only be able to click on items in the active menu (i.e., clicking on another Menu Bar item will not activate that menu but cancel the entire cascading menu as described below).

The pull-down menu will remain displayed until the user either: clicks the pointer with the pointer positioned off the active menu, presses the Cancel function, or executes a final action. When clicking off the menu, the pull-down menu will cancel and the cursor will return to the cursor parking region. When using the Cancel function, the pull-down menu will cancel and the cursor will move to the Menu Bar item from which the pull-down was called.

5.2.3.2   Cursor Movement and Selection in the Menu Bar

Once the MENU function has been activated, the cursor will automatically move to the cursor parking area and the input focus will be on the upper-left-most item in the Menu Bar (see Figure 5-2). The user may use any of the following methods to move the cursor within the Menu Bar: the pointing device (MIW mouse and PMA thumbknob), the arrow keys, or the number keys.
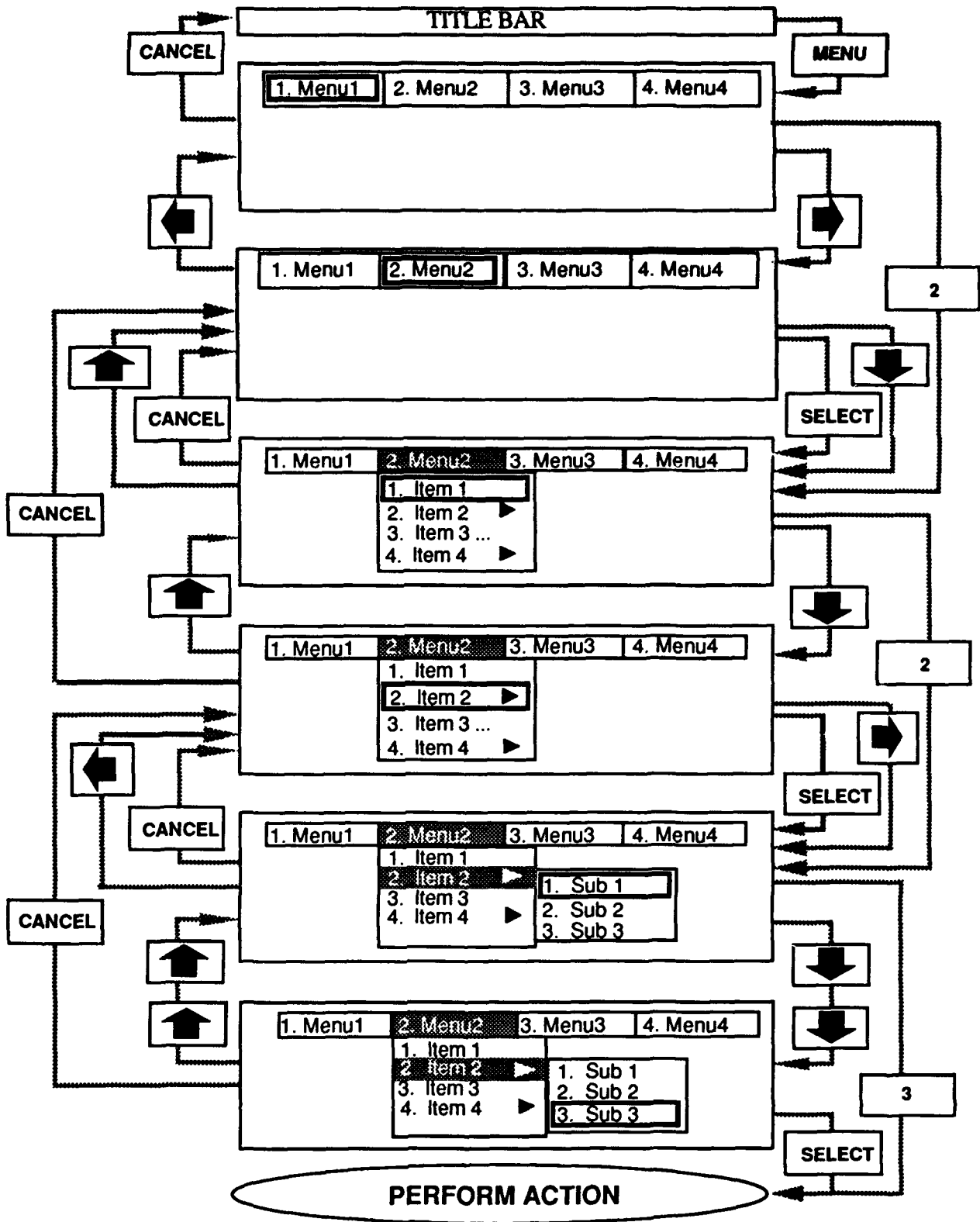
Figure 5-2: Menu Bar System

When using the cursor to select an item, the cursor will not move out of the Menu Bar. Movement will be constrained to the nine menu titles. Once the user has placed the cursor on a menu title, pressing SELECT will place the pointer on the first item in the pull-down menu.

Alternatively, the down arrow can be used in place of SELECT and the up arrow in place of Cancel from a Menu Bar.

5.2.3.3   Using the Number Keys in the Menu Bar

The number keys provide a shortcut accessing scheme within the Menu Bar. The number keys will be "hot"; that is, as soon as the user enters the menu title number, the pull-down menu associated with the Menu Bar title will be displayed and the cursor will move to the first item in the menu. This way, the user can access frequently used menu options by simply typing the numbers. The SELECT function will not be required when using the number keys in the Menu Bar.

5.3   Pull-Down Menus

Pull-down menus extend down from the Menu Bar titles. These menus provide the user with access to all system functions. Pull-down menus can also be submenus which cascade from pull-down or pop-up menus.

5.3.1 Display Presentation of Pull-Down Menus

Pull-down menus will comprise a vertical list (i.e., rows) of menu items. Within any given pull-down menu, menu items will be on a line by themselves and wrapping to the next line will not be permitted. Each menu item will consist of a numbered menu item name presented in mixed case with the initial letter upper-cased. Pull-down menu height will be determined dynamically by the number of options in the menu, but will be no less than one character high for each item. Additionally, pull-down menus can have a maximum of nine items, numbered from one to nine corresponding to the number keys. There will be a maximum of three levels of menus below the Menu Bar. Thus, there will be (at most) 6561 potential selections that will be associated with any one Menu Bar for an application.

Pull-down menus will contain three types of menu items: items which execute an action, items which display a dialog box, and items which activate a submenu. An item

which initiates an action will be displayed with no additional indicators. An item which displays a dialog box will be identified by an ellipsis (i.e., ". . .") following the item name. An item which activates a submenu will be identified by a filled-in triangle or filled-in rightward-pointing arrow (i.e., ▶) following the item name. The rightward-pointing arrows in a menu will be right justified.

Items which activate a submenu will be hierarchical. "Parent" menu items will have submenus containing items relative to that parent. These submenus will consist of a pull-down menu that cascades from the parent menu (see Figure 5-1). After the user makes a final selection (i.e., enters a dialog box or initiates an action) the system returns to the original activity from which he/she branched and the Title Bar will reappear, replacing the Menu Bar. When the user activates a dialog box from the Menu Bar, the menu hierarchy used to select the dialog function will remain on the screen in the background. This allows the user to cancel a dialog and return to the menu without traversing the Menu Bar.

Upon selecting a submenu, the Menu Bar title or the parent item will remain highlighted to indicate the hierarchical relationships among the menu choice and subsequent submenus. The highlighting scheme used to show the relationship between menus will be distinguishable from the current cursor location (typically a lighter shade or lighter border).

5.3.1.1 Pull-Down Menu Borders and Margins

The pull-down menu border will be visually distinct from the Menu Bar, adjacent menus, and other adjacent areas. Menu items will be left justified. Standard line spacing will be used to layout the menu items vertically and separate the items into selectable regions. By using this standard spacing, each selectable region will be the same height. Selectable regions within a menu will be as wide as the widest region in that menu.

5.3.1.2 Pull-Down Menu Item Deemphasis

When a menu item is NOT accessible by the user, the menu item will be grayed out. Graying out will be implemented as a pattern in the text of the menu item. That is, the background will remain constant but the text will be in a pattern that is perceived as gray. The pattern should give a gray effect while providing some visual distinction from active menu items and maintaining legibility of the menu item name. The pointer will not be able to highlight a grayed-out item. If the arrow keys are being used to position the cursor over a menu choice, the system will automatically skip over the grayed-out choices. In cases

where a color other than black is used for text (i.e., in the MIW), graying out will be accomplished by reducing the color intensity of the menu item.

5.3.1.3   Organization of Pull-Down Menu Items

Pull-down menu items will be organized into logical groups. The groups and menu items within the groups will be ranked, those most frequently used will be located towards the top of the menu. A divider will be placed horizontally between functional groups. For example, the divider could appear as a dotted line (i.e., a one-pixel-on, one-pixel-off pattern). If ordering items based on frequency is not possible, the items will be ordered alphabetically.

5.3.1.4   Scrolling Pull-Down Menus

Scrollable pull-down menus will be displayed with scroll bars (as indicated in Figure 5-3) located on the right side of the menu. Scrollable pull-down menus should not contain fewer than five items in the scrollable view.

If a pull-down menu is scrollable, the user will be able to scroll the image with either the arrow keys or the pointing device. When using the arrow keys, the menu will scroll one item for each key press in the opposite direction (e.g., when the cursor in located on the bottom of a scrollable menu and the down arrow is pressed, the menu will scroll up one item). The user will be able to scroll the image with the pointing device by either dragging the pointer off the menu in the direction to be scrolled or selecting the up/down scroll arrows. The up/down scroll arrows will temporarily reverse color to give a visual indication that they have been activated.

5.4   Pop-Up Menus

A pop-up menu is displayed on the screen when, for example, the user requests supplemental information by selecting a selectable text or graphic. In this case, the pop-up menu consists of a list of options for information which are linked to the selected item and may be selected for display and user review.

Pop-up menus may have submenus which will cascade from or extend to the side of the parent menu item.

5.4.1 Display Presentation of Pop-Up Menus

The presentation of pop-up menus will be identical to pull-down menus except for menu location and menu title. The pop-up menu will be located adjacent to the selected item. The menu location will minimize obscuring of the selected item or fill-in prompt from which it was selected.

Each pop-up menu will have a title at the top of it to indicate its purpose or content (titles are often the name of the selectable item). The title will be mixed case (with the initial character uppercased) and will be centered horizontally in the pop-up window region. The title of the pop-up menu will be separate from the menu items. The pop-up menu will be visually distinct from surrounding areas. Menu items will be visually distinct from each other and will be arranged in a single vertical column (if possible).

Pop-up menus should be limited to nine items per list, where possible. If more than nine items are required, the menu items will not be numbered and interaction will be limited to the point and select functions to select menu items. If the entire menu cannot fit into the content region, it will be scrollable (see Figure 5-3).
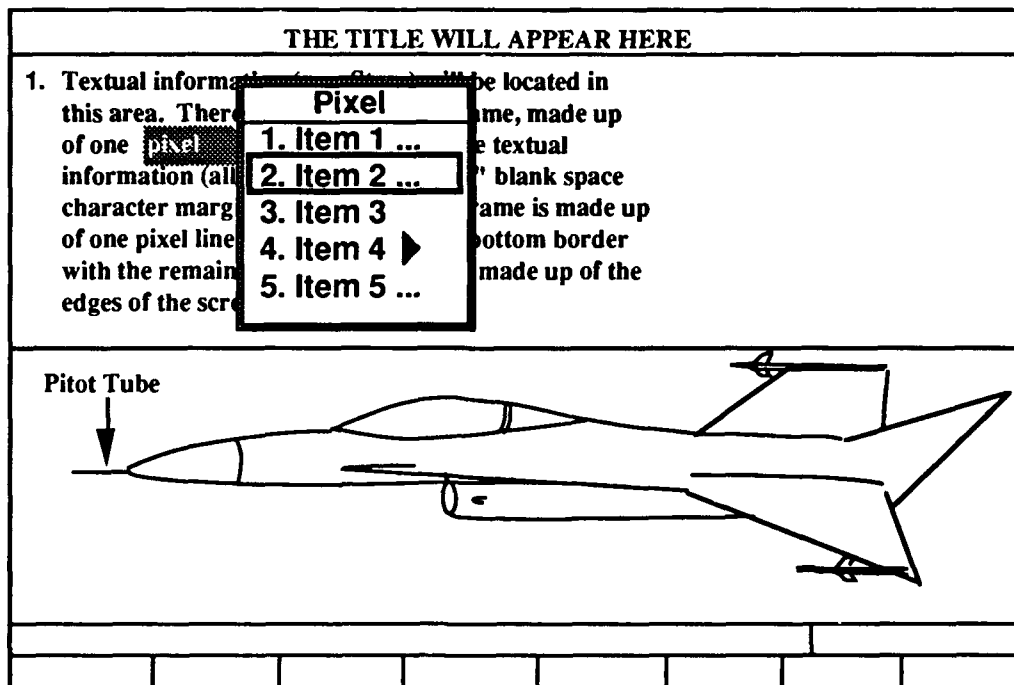
Figure 5-3: Pop-Up Menu

The scroll bars will scroll only the items in the list. The menu title will not scroll. If the user presses the up arrow (on the first item) or down arrow (on the last item) in a scrollable menu, the list will scroll in the appropriate direction. For example, in Figure 5-4, if the user were to place the cursor on item number ten and press the down arrow, the list would move up one line (relative to the window), item 11 would be displayed, and the cursor would move down onto item number 11. The scrolling mechanisms will work as described in Section 7.
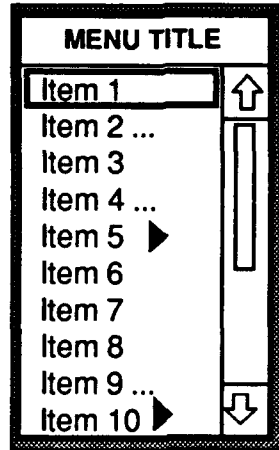
Figure 5-4: Scrollable Pop-Up Menu

When a pop-up menu is displayed, a message will appear in the message line indicating how to select items.

5.4.2 Pointer/Cursor Movement and Selection in Pop-Up Menus

Pointer movement and item selection in pop-up menus will occur exactly as described for pull-down menus except that the Cancel function must be used to remove the menu from the screen.

6. DIALOG BOXES

A dialog box is a pop-up window that appears in the content region of the window, overlying the current application. It contains graphical controls (i.e., buttons) which are used to converse with the underlying application.

A dialog box will allow a maintenance technician to acknowledge a procedure or an alert before continuing a task, access data, change system settings, or input required data into the system.

6.1   General Characteristics of Dialog Boxes

Dialog boxes are modal; that is, the user must respond to the dialog either before continuing with the application or before continuing with any system interaction. Dialogs which must be responded to before continuing with the application are called Application Modal dialogs. Dialogs which must be responded to before continuing with any system interaction are called System Modal dialogs.

The majority of Application Modal dialogs are initiated by the user by normal interaction through the data. Application Modal dialog boxes will be displayed in the center of the content region of the current application. Most dialogs in IMIS will be Application Modal.

System Modal dialogs are typically generated by the system due to a problem with the hardware or software (Open Software Foundation, 1991). System modal dialog boxes will be displayed in the center of the display device screen.

Certain characteristics, common to all dialog boxes, provide the user with visual cues for immediate recognition. Every dialog box will have, at a minimum, a title, contents (ranging from a textual message to multiple controls), selectable push buttons, and a border scheme which distinguishes it from the underlying screen. An example of a dialog box appears in Figure 6-1. The exact appearance of borders and buttons in dialog boxes are toolkit-dependent. If a dialog box results in another dialog box being displayed, the second dialog box will overlap the first but be visually distinct. The positioning of the second dialog box will overlap the push buttons of the first dialog box while attempting to not obscure the title of the first.

```
┌─────────────────────────────────────────┐
│  ┌───────────────────────────────────┐  │
│  │              TITLE                 │  │
│  │                                   │  │
│  │          Contents of the          │  │
│  │      dialog box will appear here  │  │
│  ├───────────────────────────────────┤  │
│  │ ((F1-Name))  (F2-Name)  (F3- Name) │  │
│  └───────────────────────────────────┘  │
└─────────────────────────────────────────┘
```
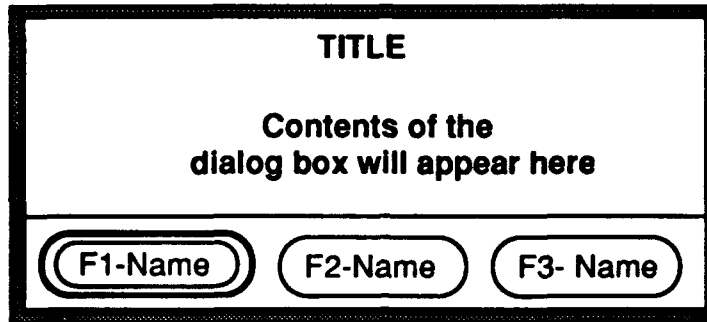
Figure 6-1:   Dialog Box Display

6.1.1 Dialog Box Title

Every dialog box will contain either a title descriptive of the contents of the box or a prompt for user action. Titles or prompts are context-specific, and will be designed in accordance with this specification and cited in application-specific documents.

The title of a dialog box will be upper-cased and centered on the top line of the dialog box.

6.1.2 Dialog Box Contents

The contents of the dialog box will appear directly below the title. The top of the contents will be separated from the title by at least one blank line. The text or graphics displayed in the contents of a dialog box will remain at least one character away from the inside of the dialog box border.

There are six kinds of dialog boxes which are differentiated by their contents: messages, single-choice (radio buttons), multiple-choice (check boxes), list boxes, fill-ins, and composite dialogs. Simple dialogs have one type of control as their contents; composite dialogs can have multiple types of controls. A description of the five types of controls that can occupy the contents of a dialog box are described later in this section.

6.1.3 Dialog Box Push Buttons

A dialog box can have a maximum of eight selectable push buttons located along its bottom border. The push buttons will be visually distinct from one another and from adjacent areas. If appropriate, the buttons can be arranged in two rows rather than one.

The push buttons that appear in the dialog box will also appear as currently available functions activated by the function keys. Those push buttons which correspond to function keys will be redundantly labeled on the function key label line. The entire function name will appear on the dialog push buttons preceded by the function key label and a dash (e.g., "F1-") while the corresponding function key labels may be truncated to fit in the function key area.

The text label for each push button will be visually distinct from the button perimeter. Generally, the first letter of the text labels will be upper-cased.

6.1.3.1   Push Button Actions

The selectable push buttons can represent any number of functions or actions. There is not a defined list of possible push button actions; however, the following are examples of potential candidates. An "OK" button could be used to represent an acknowledgement action. In other words, by selecting the "OK" button, the user would acknowledge that the dialog box had been completed. "CANCEL" is another possible button. "CANCEL" would cause the dialog box to disappear, disregarding any interaction made with the dialog box.

Similar to menu items, dialog boxes will contain three types of push buttons: push buttons which execute an action, push buttons which display another dialog box, and push buttons which activate a submenu. A push button that initiates an action will be displayed with no additional indicators. A push button that displays another dialog box will be identified by an ellipsis (i.e., ". . .") following the function name. A push button that activates a menu will be identified by a filled-in triangle or filled-in rightward pointing arrow (i.e., ▶) following the function name.

6.1.3.2   Push Button Deemphasis

Push buttons will only be available when their functions are applicable to the current tab group. When not applicable, the push button will be grayed out (or dee phasized in a similar fashion). Additionally, the soft-function key labels corresponding to the soft-function key will be removed if not applicable to the current tab group.

6.1.3.3   Push Buttons and Function Keys

Each push button will have a corresponding function key. Therefore, the user may select the desired action by: (1) tabbing the cursor to the group of push buttons and using the arrow keys to select the appropriate push button, (2) positioning the pointer over the desired selectable button then using the pointer select function, or (3) pressing the appropriate function key.

6.1.3.4   Default Push-Button Action

A default push button enables the user to easily select the most likely response to a dialog-box query by using the Enter (Return) function on the MIW. In situations where a common or obvious selection exists, a default push button can be identified. The default push button will be visually distinguishable from the other buttons.

As a rule, the default responses to a question will be selected to require a positive response and avoid destructive transactions. For example, dialog boxes would ask, "Do You Want To Save Session?" with a default of "Yes," instead of "Do You Want To Save Session?" with a default of "No."

6.1.3.5   Cancel Push Button

The user can select the Cancel push button anytime the dialog box is displayed to make the dialog box disappear, disregarding any interaction with the dialog box. The user would then return to the point in the system at which he/she began branching to the dialog box.

6.1.4 Pointer/Cursor Movement and Selection within Dialog Boxes

Users will typically interact with dialog boxes by interacting with the contents, then acknowledging or canceling the dialog box via push buttons to close the box. The complexity of the first step depends on the contents of the dialog box and can range from reading text (no interaction) to selecting multiple controls.

The pointer can be used to select any selectable item in the dialog box at any time. However, dialog boxes are composed of tab groups which constrain cursor movement within a group of selectable items in the dialog box.

6.1.4.1   Cursor Movement within Dialog Boxes

The arrow keys will move the cursor between selectable items within a tab group. The type of movement is dictated by the type of dialog component. Cursor movement within each dialog component is described in the following sections.

In general, when a dialog box is displayed on the screen, the default cursor location will be in the upper-left-most selectable item of the upper-left-most tab group in the dialog box contents. To select a different item within the same tab group, the user would: (1) use the arrow keys to position the cursor over the item of interest and use the select function; (2) place the pointer over the item of interest and click the pointer select button; or (3) if there is an assigned number or function key, press the assigned key (see Section 4 for more information on Pointer Movement and Selection).

Once the user has finished making an entry(ies) in the dialog box, the user will select a "CONFIRM" or "OK" push button to indicate that the data entry process has ended and the entered data is to be saved.

6.1.4.2   Tab Groups within Dialog Boxes

The contents of the dialog box may be separated into tab groups to create a sequential interaction with the user. For example, the dialog box may require that two fill-ins and a single item be selected from a list of options. In this case, the dialog box would have four tab groups: one for each of the two fill-ins, one for a radio-button list, and one for the push buttons. To interact with the dialog box via the keyboard, the user would enter the first fill-in, press Tab, enter the second fill-in, press Tab, select a radio button, then choose to either Tab to the push buttons or press a function key to close the dialog box.

Forming tab groups within a dialog box involves grouping like controls. Each tab group should be a set of similar selectable items that answer a common question or set a common variable within the system. Likewise, several tab groups may answer a common question or set a common variable and should be grouped in sequence. Each tab group (or combined common tab groups) should have a prompt describing the question to be answered or the variables to be set. The prompt for a tab group may be displayed either to the left of the selectable items (if the items are arranged in a row) or directly above the group (if the items are arranged in a column or column and row).

The following contents will form tab groups:

- set of radio buttons,

- check boxes which are the possible choices from a set,

- items in a List box,

- characters in a fill-in,

- set of dialog box push buttons and,

- scroll bars.

Tab groups will be distinguishable by placing a border or other marking around the set of common controls. When multiple tab groups exist in a dialog box, they will be arranged in left-justified columns. When multiple columns exist, the columns will be left justified (where possible) and visually distinct.

6.1.4.3   Movement Between Tab Groups

When moving between tab groups, the cursor will be positioned on the upper-most selectable item within the tab group except for fill-ins. Tabbing will occur across rows (left to right). Repeating the tab function will cycle the input focus through all the dialog box controls and finally the push buttons. For example, if there are multiple columns of tab groups, the input focus will shift across the first row until the right-most item of the contents is reached. Further tabs will wrap the input focus to the left-most item of the second row and eventually across to the right side. This process will continue until the last tab group in the dialog box is reached (the bottom-right corner of the dialog contents). Pressing tab from the last content group will shift input focus to the dialog push buttons. Pressing tab from the push buttons will return the keyboard focus to the original (top-left-most) tab group.

6.2   Dialog Types

There are six kinds of dialog boxes which are differentiated by their contents: messages, single-choice (radio buttons), multiple-choice (check boxes), list boxes, fill-ins, and composite dialogs. A description of the dialog types is contained in this section.

6.2.1 Message Dialog Boxes

Messages will be any communication, notice, or output that requires acknowledgement by the user, such as "Battery Low." Messages will be generated as a result of erroneous user inputs or sequence-control actions. Messages will provide information regarding the processing status of user inputs and requests. Messages will also provide information about the status of the internal system components (e.g., low battery power, improper functioning of the operating system or memory module, etc.). Messages may also include warnings or cautionary messages to the user about potentially destructive data/command entries before they are executed by the computer.

Messages will contain a succinct title which briefly describes the message. The contents of the message will contain a description of the reason for the alert and any user alternatives to respond to the alert.

Messages typically will only have to be acknowledged; therefore, the "OK" push button may be the only push button indicated. "CANCEL" and "Help" may also appear in alert dialog boxes as well, making the "OK" button a likely default button candidate.

6.2.2 Single-/Multiple-Choice Dialog Boxes

There are two types of choice dialog boxes, each with two types of buttons. All choice dialog boxes have push buttons for indicating selected functions. In addition to push buttons, choice dialog boxes may have either radio buttons or check boxes. Radio buttons are used in dialog boxes when a single item in a list is to be selected. Check boxes are used in dialog boxes when the user is to make one or more selections from the same list.

6.2.2.1   Radio Buttons

Radio buttons will be grouped into lists of mutually exclusive choices. Radio buttons will be separated from their associated text descriptions by a blank space. If there are so many choices in the dialog box that the choices appear in columns, the button position will be left justified.

The user will make a single selection from the group of choices in one of three ways: (1) placing the pointer on the choice and pressing the pointer select button; (2) using the arrow keys to highlight the choice and pressing select ; or, (3) pressing the number key

associated with the choice (if the items are numbered). This interaction will move the cursor **and** turn on the selection. When a selection is made, the radio button will visually change to indicate the selection. A sample Radio Button Dialog Box appears in Figure 6-2.
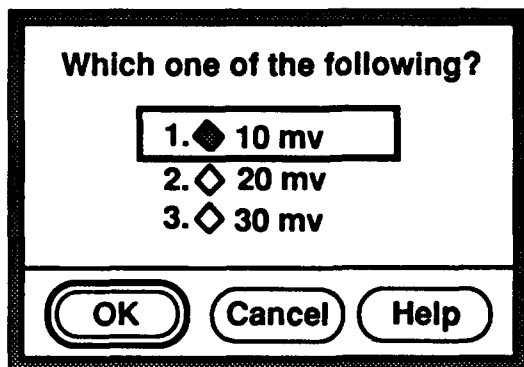
Figure 6-2: Radio Button Dialog Box

Only one choice in a dialog box with radio buttons can be filled in at any given time; therefore, it is possible to have a default choice indicated upon display of the dialog box. If a default is going to be indicated, it must be specified by the designer/author.

6.2.2.2   Check Boxes

Check boxes will be grouped into lists of nonmutually exclusive choices. Check boxes will be separated from text descriptions by a blank space. If there are so many choices in the dialog box that the choices appear in columns, the button position will be left justified.

When keyboard focus is shifted to a list of check boxes, the cursor will reside on the upper-left-most choice. The user may select one or more choices from the group of choices by placing the pointer on the choice and pressing the pointer select button or using the arrow keys to place the cursor on the choice and pressing SELECT. Alternatively, the user can turn off the selection by using the select function. If the items are numbered, the user can make a selection by pressing the number key associated with the choice. This interaction will move the cursor **and** turn on/off the selection. Once a check box is selected, the box will become visually distinct from an unselected check box. A sample Check Box appears in Figure 6-3.
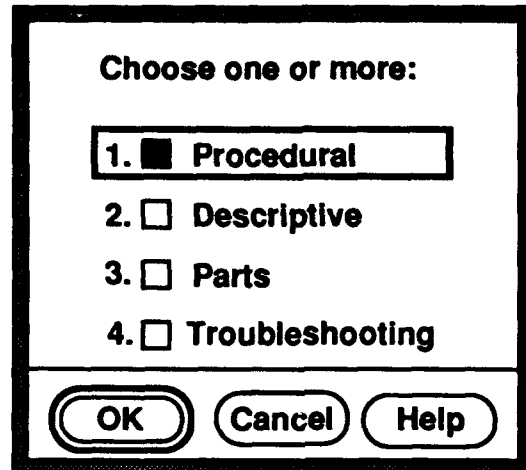
Figure 6-3: **Check Box Dialog Box**

6.2.3 List Boxes

List boxes are used in dialog boxes to present the user with a list of items on which to perform some action (e.g., a list of bookmarks to be accessed, configuration item codes, or a list of standard narratives to be selected by a debriefer). The display for list items will be similar to that of pop-up menus except that the list box is permanently displayed in the dialog box.

A title, descriptive of the contents of the list or a prompt to the user, will appear at the top of each list. The title will be centered above the list and will be visually distinct from items on the list. The title will not scroll. Items in lists will consist of descriptive labels, each beginning with a capital letter. A list box dialog box will include appropriate push buttons (e.g., Review, Edit, Go To, etc.) descriptive of the actions to be performed on the items in the list in addition to the standard navigation buttons (O K, Cancel, and Help).

Lists may be of any size. If the entire list cannot be displayed within the dialog box at one time, it will be accompanied by a vertical scroll bar. The scrollable view will contain no less than five items. The scroll bar will conform to the description in Section 7 and will be used as described in that section. List boxes will be wide enough to accommodate the longest entry (i.e., the list will not scroll horizontally).

In addition to using the scroll bars, the user can also scroll the list by pressing the up or down arrows. When scrolling with the arrow keys, the list will scroll up or down one item per arrow key press.

A search box, used for character entry searches, may be attached to the list. In this case, the search box would behave like a fill-in but the dialog box would have a push button to initiate a search on the items in the list. Exact characteristics of the search capabilities are TBD.

Like menus, lists may have sublists. The display of lists with sublists will be hierarchical as described in Section 5. A list item with subitems will have a triangle to the right to indicate that a sublist exists under that item. Once the sublist is displayed, the triangle will become outlined as shown in Figure 6-4. Sublists will be left justified and indented three spaces from their parent item.
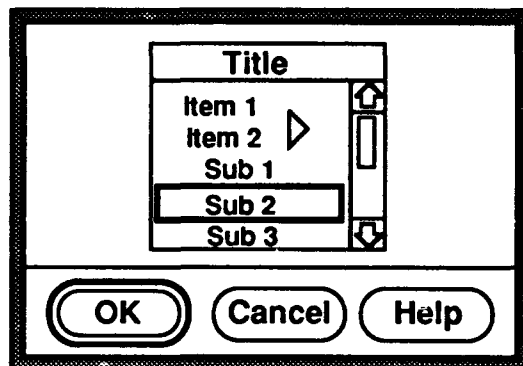
Figure 6-4: List Box

List boxes will behave as depicted in Figure 6-4. When input focus shifts to a list box for the first time, the cursor will rest on the top item. If a previous selection has been made, the cursor will appear on that item. The user can press the arrow keys to move the cursor up and down the list to point at an item in the list. Alternatively, the pointing device can be used to move the cursor to any item on the list. Once the cursor is located on the item of interest, the user can activate a push button to perform an action on the chosen item.

If a list item has subitems, the user can display the sublist by double clicking the pointer select button (once to move the cursor and once to expand the sublist) or placing the cursor on the item and pressing select. To return to the parent level from a sublist, the user can position the cursor on the parent item and press select (double click on the parent item) or select any item at the parent level.

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Once the user shifts input focus from a list box, the item on which the cursor was last positioned will be deemphasized (by turning the highlighting from black to gray or some other method that is distinguishable from the current cursor location).

6.2.4 Fill-Ins

Fill-ins provide a way to input alphanumeric characters in response to displayed questions and/or data entry fields (e.g., inputting user identification data when "signing-on" to the computer system). Fill-ins consist of: (1) prompts or labels, which include names for the fields that require input; (2) data-entry fields or a box in which the input data will appear; and (3) a method for data entry, either a keyboard or a list contained in a pop-up Menu.

Data that is displayed but which may not be edited is called a read-only fill-in. The read-only fill-in will be similar yet visually distinguishable from regular fill-ins.

6.2.4.1   Display Presentation of Fill-Ins

Data entries will be prompted explicitly by displayed labels for data fields and/or associated user-guidance messages. Field labels will consistently indicate what data items are to be entered, always employing the same label to indicate the same kind of entry. This means that when the system needs to have a date entered, it always uses the same label to ask for the Julian date. It would not ask for the date one time and for the Julian date another.

When the user moves the cursor to a fill-in, the box will be highlighted (outlined) and the cursor will change into an input cursor. The input cursor will be positioned to the left of the last character in the fill-in. Once the entry has been completed and confirmed, the box will be de-highlighted.

Labels for fill-ins will be distinctive such that they cannot be confused with data entries, labeled control options, guidance messages, or other displayed material. Field labels will be placed in close proximity to their respective data entry area and will end with a colon (:). The data entry area will follow the colon and be separated from the colon by adequate space to make the data entry field visually distinct. The field area will be outlined

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with a box. Fixed or maximum acceptable data entry length will be visually indicated with broken-line underscores. For example:

Man Number: ‾‾‾‾‾‾‾‾‾ ‾ ‾ ‾ ‾ ‾

Once the entry has been completed, the system will automatically justify the entry and remove any unused underscores. For single data fields, the label will be placed to the left of the data field. For example:

Producer: [   ]

For multiple entry fields, the fields will be located on the line below the label and will be indented with a box surrounding each entry. For example:

Producers:

[   ]

[   ]

[   ]

When fill-ins are formed into columns, the labels will be left justified and entry boxes will be left justified.

Read-only fill-ins will not have a box for entry. For example:

Producer: 77017

6.2.4.2   Pointer/Cursor Movement and Selection with Fill-Ins

There are basically two types of input for fill-ins: numeric and alphanumeric. Either type may be input via free-form entry using the keypad (or keyboard) or selection from a pop-up menu containing a list which the user calls up. The mode of entry will be based on the capability of the presentation system to supply the user all items for a list. If the presentation system cannot provide the list, the user will enter the fill-in via alphanumeric entry.

In the MIW, the alphanumeric keys are contained on the keyboard which is a hardware component. On the PMA, the keypad will contain hard keys for numeric entry (numbers zero through nine) and alphanumeric characters will be input via a software-generated keyboard presented on the display.

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6.2.4.2.1 Cursor Movement and Selection Between Fill-Ins

Each fill-in in a dialog or form is a tab group with individual characters as the set of selectable items. The user will choose a fill-in by either tabbing to the fill-in via the TAB key or moving the pointer to the fill-in and pressing the pointer select key. The cursor will not visit read-only fill-ins.

In the Tab method, the input cursor (as depicted in Section 4) will be positioned directly to the right of the last character in the fill-in. In the pointer method, the input cursor will be positioned directly under the pointer position when the pointer select button is pressed. If the fill-in is empty, the cursor will appear in the first character position.

The user will input data into fill-ins as described in the following section. Once the user has completed the entry, the cursor can be moved to another dialog component by pressing the TAB key or using the pointer. The user will not be able to change the input focus from the selected field unless an explicit action is taken (e.g., Tabbing to another field or Canceling the dialog).

6.2.4.2.2 Cursor Movement and Character Entry within a Fill-In

Once the input focus is on a fill-in, the user can input characters with the keyboard, keypad, or software-generated keyboard (PMA only). In any case, the cursor movement scheme is the same despite the type of character entry.

The default character entry mode will be the insert mode. The user will be able to switch between the insert and overstrike modes by changing settings in the pointer setup option. When the user inputs a character, the cursor will move to the right and the character will be displayed to the left of the cursor. If the character is being input into the middle of a character string, the entire string to the right of the cursor will move one character to the right.

The left and right arrow keys will move the cursor character-by-character in the indicated direction. If the fill-in has multiple entries, the up and down arrow keys can be used to move the cursor to the next line of the box. The cursor will not wrap to the next line of text in a multiple fill-in. The user will not be able move the cursor out of the active fill-in with the arrow keys. The arrow keys will repeat; that is, if the user holds an arrow key down, the cursor will continue to move in the indicated direction until the arrow key is released.

Alternatively, the pointer can be used to position the cursor at any location in the character string as indicated in the previous section. The user will also be able to select a group of characters in a string by dragging the pointer over the group and releasing the pointer select button.

The user will be able to delete the character preceding the current cursor position by using the Delete function. If a group of characters is selected, the Delete function will remove the selected group from the fill-in. Like the arrow keys, the Delete function will be a repeating function.

After entering data into a field, the user indicates data entry completion by pressing the tab key or selecting another tab group with the pointer.

6.2.4.3   Fill-In Entry via Keypad

The number keys on the keypad or keyboard can be used to input numeric data. If the software-generated keyboard is currently displayed, the user has the option to enter numeric characters from the number keys on the keypad or the software-generated keyboard.

6.2.4.4   Fill-In Entry via Alphanumeric Keyboard

For the MIW, the user will input alphanumeric characters directly into the fill-in using the MIW keyboard. For the PMA, the user will enter alphanumeric characters into a fill-in with the software-generated keyboard. The keyboard will be available through the Keyboard function.

The PMA alphanumeric keyboard will be displayed as shown in Figure 6-5. The keyboard has three tab groups: input area, keys, and dialog box push buttons. The default input focus is on the alphanumeric keys. If data exists in the fill-in, the data entry area of the keyboard will contain the previously entered data. A vertical bar will appear to the right of the last character in the keyboard entry window to indicate the current insertion point. The vertical bar will be visually distinguishable from the I-beam cursor.

Fill-In Title

```
A B C D E F G H I J K L M
N O P Q R S T U V W X Y Z
1 2 3 4 5 6 7 8 9 0 .  SPACE
```

OK   Cancel
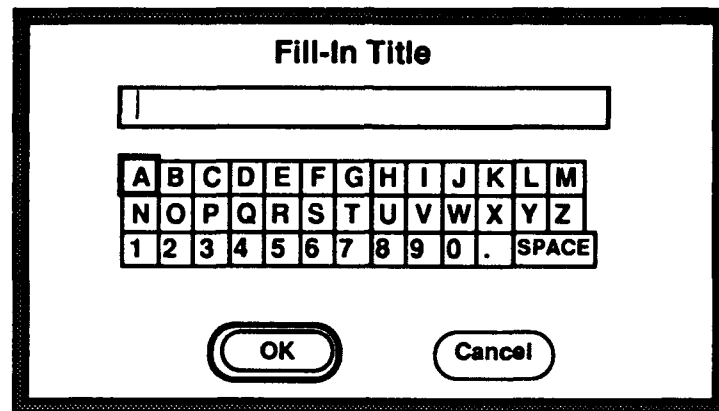
Figure 6-5:   Software-Generated Alphanumeric Keyboard

To input characters, arrow keys or the pointer is used to position the cursor over the desired character; SELECT is then pressed to input that character into the keyboard entry window. The keyboard entry window will be sized to fit the expected input. If necessary, the entry window will allow for multiple lines of text; as the window fills up, the text will wrap to the next line.

The user will move the insertion point in the keyboard entry window by pressing the TAB key to change the input focus of the arrow keys from the keyboard to the entry window. At this time the vertical bar will change into the cursor I-beam. The user then uses the arrow keys to move the cursor to the desired character to be changed and presses the TAB key to change the focus of the arrow keys back to the keyboard. Using the arrow keys the user chooses the appropriate character and presses SELECT to place the new choice in the entry field. The insertion point moves automatically to the next character position.

When the focus of the arrow keys is the data entry area, the user can also hit the DELETE key to move the cursor one character to the left and delete that character.

To transfer the contents of the keyboard entry window to the alphanumeric fill-in, the user must use the confirmation button (e.g., Enter or "OK") or press the corresponding function key.

6.2.4.5   Fill-In Entry via Pop-Up Menus

As an alternative to typing fill-ins, a list of items may be available from which the user can select to enter into the fill-in (e.g., aircraft tail numbers, Work Unit Codes

[WUCs], or How Mal codes). In this situation, the presentation system will provide an options function. The options function will open a pop-up menu containing the list of alternative inputs for the fill-in.

When a list of options is available for a fill-in, the label of the fill-in will appear raised to indicate that options are available The user may use the options function key or place the pointer on the entry label and press SELECT.

When activated, the options menu will overlay the fill-in but will not obscure the field in which the user is to enter data. If the list is long, it will be scrollable and will be displayed with a scroll bar as described in Section 5. After selecting an option from the menu, the menu will disappear, the selected option will be placed in the fill-in, and the cursor will be positioned at the end of the entry. If data previously existed in the fill-in, the selected option will replace the old data.

The Cancel function will remove the pop-up menu and place the cursor in the active fill-in. The cancel button on the dialog box will be deemphasized when any pop-up menu overlays it.

6.2.5 Composite Dialog Box

A composite dialog box will consist of any combination of the dialog components described in this document (radio buttons, check boxes, list boxes, and fill-ins). Composite dialog boxes will be displayed as described earlier in this section. Pointer/cursor movement and selection will be as described in relation to tab groups and the same as described for each dialog component (see Section 6.2.4.2, Pointer/Cursor Movement and Selection with Fill-Ins). An example interaction with this dialog box is described in the next paragraph.

The dialog box in Figure 6-6 has six fields which form tab groups: two fill-ins, a list of check boxes, a list box, the scroll bars for the list box, and the dialog box push buttons. To interact with this dialog box using the keyboard, the user must use the arrow keys and number pad (or keyboard) to enter/edit the first entry, then press TAB to place the input cursor in the second entry. The user would enter/edit the second entry, then press TAB to place the cursor on the first check box in the list of check boxes. The user would use the arrow keys and press SELECT to interact with the check boxes, then press TAB to move the cursor to the first item in the list box. If the list needed to be scrolled, the user would press TAB to shift the focus from the keyboard to the scroll bars and use the arrow

keys to scroll the list (Section 7 describes scrolling). After scrolling to the appropriate place in the list, the user would press BACKTAB to move the cursor back to the list. The user would then use the arrow keys and SELECT function to choose an item from the list.

COMPOSITE DIALOG BOX

Entry: |

Entry: [   ]

Which One(s)?
1. ■ Choice 1
2. ■ Choice 2
3. □ Choice 3

Title
Item 1
Item 2 ►
Item 3
Item 4

(OK)   (Cancel)   (Help)
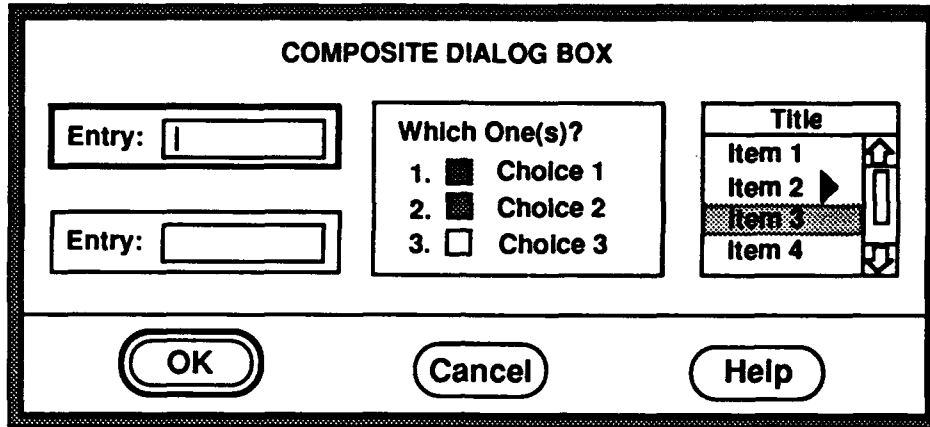
Figure 6-6:   Composite Dialog Box

After completing interaction with the contents of the dialog box, the user would tab to the dialog box push buttons and select the OK button (alternatively, the user could press the function key assigned to the dialog box push buttons).

7. DATA PANES

This section describes the primitive data panes (text, graphics, tables, etc.) that may be displayed in the content region of any IMIS application.

7.1 General Characteristics of Data Panes

A screen of technical information consists of one or more data panes. For instance, the screen may display a procedure and a graphic illustrating the parts relevant to the procedure; in this case, the screen would consist of two data panes (a text and a graphic pane). A data pane may contain one of the following types of information: text, graphics, tables, or video.

7.1.1 Display Presentation of Data Panes

Data panes will be displayed in the content region. If a text pane is present, text will begin in the top-left corner of the screen. Also, the text and graphics will be arranged to allow the best graphics presentation on the screen. In general, text panes will be presented on the top or left side of the screen with graphics and/or tables presented to the bottom or right side. One or several panes may be presented on a screen at one time. Data pane size will be determined by the application and will be appropriate to the displaying hardware.

7.1.2 Pointer/Cursor Movement and Selection within Data Panes

Typically, each data pane will be in a separate tab group. Within a data pane, the user can move the pointer or cursor between selectable items as described in Section 4 of this document. Additionally, the user can highlight and Select any selectable items from within a data pane. For example, a graphic may have several call-outs. Any of these call-outs could be a selectable area from which the user could branch off and retrieve supplemental information about that graphic call-out. Numeric selection by the number keys is also possible in data panes; however, data panes may contain numbers relevant to the pane which may or may not be selectable.

7.2 Text

Textual information will consist of alphanumeric data comprising letters, words, sentences, paragraphs, numbers, etc., displayed for user review. The following paragraphs describe the display of text within an IMIS application.

7.2.1 Text Fonts

Each display region uses different text fonts to distinguish the types of information displayed. All system information, such as menus, dialog boxes, and system messages, will be displayed in a System Font. All information content will be displayed in a Normal Font or a Title Font. The three fonts are described in Table 7-1.

Table 7-1: Text Fonts

	Font	Regions
Normal Font	The Normal Font will be a serif style font. The PMA font should be at least .13 inches high on the screen. The MIW font should be at least .10 inches high on the screen.	Content Region
Title Font	The Title Font will be a serif font one size larger than the Normal Font.	Title Bar Content Region
System Font	The System Font will be a sans-serif style font. For the PMA, this font should be at least .13 inches high on the screen; for the MIW, the system font should be at least .10 inches high on the screen.	Menu Bar Menus & Dialogs Message Line Function-Key Labels

All fonts shall contain both upper-case and lower-case letters. For the PMA, the smallest character size will be no less than 0.13 inches (.33 cm) in height (assuming a three-foot viewing distance and viewing angle of 12 minutes of arc). For the MIW, the smallest character size will be no less than 0.10 inches (.25 cm) in height (assuming a two-foot viewing distance and a viewing angle of 12 minutes of arc). Optimal character width is 75 percent of the character height. The character set to be used for special characters is TBD.

7.2.1.1 User-Controlled Font Size

The user will be able to change the font size in the content region by choosing an alternative font size from the Menu Bar. The user cannot change a graphic or table font size. If the user increases the font size, less information will be displayed at one time. If the font size selected by the user results in the possibility of less than one logical unit of information being shown (e.g., procedural step), the text pane will become scrollable (scrolling is described later in this section).

7.2.1.2 Character Specifications

Character specifications will conform to those listed in Table 7-2 (American National Standards Institute, 1988).

Table 7-2: Character Specifications

Display Characteristic	PMA	MIW
Viewing Distance	36"	24"
Minimum Viewing Angle	12 Minutes of Arc	12 Minutes of Arc
Minimum Character Height	0.13"	0.10"
Character Width (0.9 Character Height)	0.10"	0.09"
Between Character Spacing (0.1 Character Height)	0.01"	0.01"
Total Character Space Width (Character Width + Space)	0.11"	0.10"
Between Word Spacing (One Character, i.e., "N")	0.10"	0.09"
Between Line Spacing (0.15 Character Height)	0.01"	0.02"
Margins on All Borders (One Character Space Width)	0.12"	0.10"
Line Height (Character Height + Line Space)	0.15"	0.12"

7.2.2 Considerations in Character Case Display

Textual displays will use standard character cases. For example, upper-case characters will be used for the first letter of the first word of a sentence and lower-case characters will be used throughout the rest of the sentence. For captions, labels, and visual search tasks, upper-case letters will be used.

7.2.2.1   Justification

Left justification of text will be used for all lines of text displayed as sentences or paragraphs, leaving ragged right margins.

The system will provide the capability to wrap lines of text so that no line will extend beyond the limits of the text pane margins. If the text is re-sized (due to a font size change) and extends beyond the viewable text pane, the system will wrap the lines of text so that no line extends past the right margin. Only as a last resort will a text pane become scrollable.

7.2.2.2   Highlighting Text for Selection

As described in Section 4, there are two types of selectable items: primary task items (such as dialog box components and menu items) and textual information with reference links to other maintenance information. The user knows that primary task items are selectable through training or guidance supplied via prompts. Textual information that contains reference links to other maintenance information will become selectable after the supplemental information function is invoked. After the use of the Supp Info function, these items are indicated by appearing in a raised (3D) or bordered (2D) area. If the user positions the cursor on one of these areas (or items), the area will become highlighted. At this time, the user may press SELECT to display a pop-up menu with the information linked to the selected item.

7.3   Graphics

Graphics are illustrations or drawings that visually describe a component or process in the maintenance environment. The following paragraphs describe graphics displays within an IMIS application.

7.3.1 Display of Graphics

The default size of a graphic as displayed on the screen will be the original size of the graphic as entered in the data base. Composite (or complex) graphics will be composed of graphic primitives.

The graphic will be displayed in a graphic data pane which is visually distinct from adjacent regions (i.e., text pane, header, and message line). Margins for a graphic data pane will be wide enough to allow visual distinction between the graphic and the border of the data pane.

7.3.2 Highlighting Graphics for Selection

Like text, graphical information may contain reference links to other maintenance information. Selectable items of a graphic will be indicated as specified in Section 4 of this document. After using the Supp Info function to identify the call-outs or graphic primitives with supplemental information, the user will move the pointer over a selectable region. At this time, the user may press SELECT to display a pop-up menu with supplemental information about the item selected.

7.4 Tables

Tables are individual entries (cells) of data arranged in a matrix. Tables have descriptive labels for rows and/or columns called headers. The following paragraphs will describe the display of tables within an IMIS application.

7.4.1 Display of Tables

Tabular data will be displayed in a left-to-right, top-to-bottom array. All tables will have column headers; when appropriate, tables will also have row headers. All cell entries will be numeric and/or alphanumeric. There will be explicit borders separating all cells within the table with at least one character width between the cell entry and the border.

7.4.1.1   Justification

Textual (alphanumeric) cell entries will be left justified at the one-character margin. When five or more alphanumerics are displayed and no natural grouping exists, characters

should be grouped in blocks of three to four characters with a minimum of one character width separating the groups (e.g., A12 345 678 as opposed to A12345678). Numeric data (without decimal points) will be right justified (allowing for the one-character-wide right margin). Decimal data will be aligned on the decimal point (see Table 7-3).

Table 7-3: Table Layout

Text	Numeric	Decimal
Sample Text	8437	48.28
Text	28	8.0
More Text	439	6.8
Still More Text	26	4.333

7.4.1.2 Column Spacing

There will be at least two characters separating each column of data with a line bisecting the two spaces. Therefore, two adjacent cells will share the vertical border.

7.4.1.3. Row Spacing

There will be at least two characters separating each row of data with a line bisecting the two spaces. Therefore, two adjacent cells will share the horizontal border. There will be at least .33-character-height spacing between the rows of a table, as is the case for lines of text. (For additional information, see Table 7-2.)

7.4.2 Highlighting Tables for Selection

Like text and graphics, tabular information may contain reference links to other maintenance information. Selectable items of a table will be indicated as specified in Section 4 of this document.

7.4.3 Alphanumeric Input in Tables

Tables may be editable so that a user may interact with individual cells of a table like a spread sheet. For example, the scheduler may be able to update or override the current

schedule which may be displayed in a tabular format. Exact pointer/cursor movement, selection, and character entry of editable tables is TBD.

7.5   Video

The display and user interaction requirements for video information are TBD.

7.6   User Prompts

The purpose of user prompts is to obtain information from the user using dialog box components: radio buttons, check boxes, list boxes, and fill-ins (as described in Section 6). There are three types of prompts: (1) dialog box prompts overlaying a data pane; (2) embedded prompts in a text data pane; or (3) forms which use the entire screen.

7.6.1 Display of User Prompts

Each of the three user prompts has unique display characteristics. Dialog box prompts are displayed as described in Section 6. Embedded prompts and forms are displayed as described in the following sections.

7.6.1.1   Display of Embedded User Prompts

Prompts embedded within a text pane will be displayed in the normal font. Depending on the content of the embedded prompt, the presentation should resemble the components of a dialog box, except that there will be no border or push buttons included in the initial display of the prompt.

7.6.1.2   Display of Forms

Forms are prompts in the main thread of IMIS which are displayed in a data pane consisting of the entire content region. Forms can contain any of the dialog box components described in Section 6. User interaction and display of forms will be identical to dialog boxes with the following exceptions.

- Forms will not have a border (the form is the underlying screen).

- Forms will not have dialog box push buttons (the function keys will be labeled).

- The user can access the menu bar while in a form.

- The MIW Enter key will submit the form to IMIS (mapped to OK).

7.6.2 Pointer/Cursor Movement and Interaction with User Prompts

The user will be able to interact with an embedded prompt in the same manner as he/she would in a dialog box (see Section 6).

Multiple-component prompts will be arranged in Tab Groups. If the embedded prompt has a default answer, it will be filled in. The technician has the opportunity to respond to the prompt (or change the default answers) by numeric/function key, cursor, or pointer selection as described in Sections 4 and 6.

After answering the prompt, the user will use the NEXT function to signal the completion of the current transaction and move on to the next unit of information.

7.7   Manipulation of Data Pane Contents

The contents within a data pane may, at times, require the user to manipulate them in order to access the desired information. Manipulation includes the following:

(1)   SCROLL Function: move the contents up, down, left, or right within the pane (if the contents are larger than the pane); and

(2)   HOME Function: return the image to its original state after scrolling has occurred.

These functions do not actually change the size of or move the data pane itself; they simply manipulate the contents of the data pane.

7.7.1 Scrolling Data Panes

The user will be allowed to scroll the contents of a data pane when the contents are too large to fit within the parameter of the pane presented on the screen. In this case, the scroll function will be indicated to the user as being available through the display of scroll bars. When scrolling is available, the user will be able to scroll the image by selecting controls on the scroll bars with the pointing device or by shifting keyboard focus to the scroll bars and moving the image up, down, left, or right via the arrow keys.

7.7.1.1 Scroll Bars

If vertical scrolling is available, the scroll bar will be placed vertically on the right side of the data pane. If horizontal scrolling is available, the scroll bar will be placed horizontally on the bottom of the data pane. If scrolling is permitted in all four directions, both scroll bars will be presented within the data pane in the locations specified above (see Figure 7-1). The style of the scroll bars will be determined by the tool kit selected.
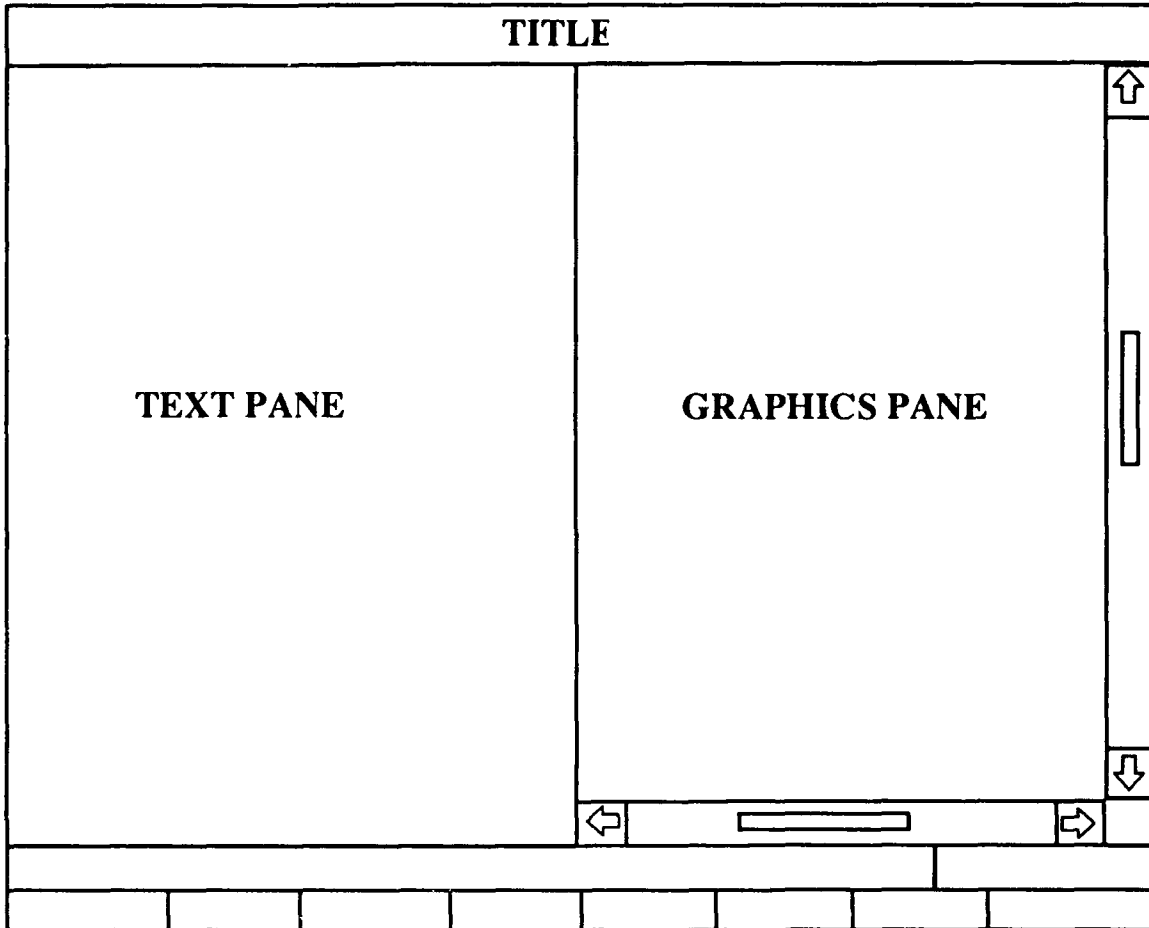
Figure 7-1: Inactive Scroll Bars

Within the scroll bar area, a rectangular box or a slider box will indicate the data pane view in relation to the entire scrollable area. This slider box will change in size relative to the size of the total scrollable area. Finally, there will be two stepper arrows on the scroll bar. These arrows will move the slider box in the direction indicated (i.e., the data pane will move in the opposite direction). For instance, if the user clicks on the top

stepper arrow, the arrow will briefly highlight, the slider box will move up, and the data within the pane will shift down.

7.7.1.2   Scrolling Mechanics

Movement of the image while in the scroll mode has several components: the arrow keys or mouse and the distance which the image moves each time the user scrolls. It will not be possible to scroll the image diagonally.

The scroll distance indicates the distance the image will move each time the user indicates a direction to move. Scroll distance will be variable, and the variation will depend on the data type and software tool kit used for implementation. Stepper arrows typically move the image in small increments while the slider box moves the image larger distances. For example, scroll distance for graphics may be either one, ten, or 50 pixels at a time, or one page at a time (a page is equivalent to one displayed data pane). Scroll distance for tables can be one cell at a time (via the stepper arrows) or one page (view) at a time. The scroll distance can be altered using the Pointer Setup dialog box described in Section 4.4.

7.7.1.2.1   Scrolling with the Pointing Device

The user can interact with a scroll bar at any time using the pointing device. Once the pointer is on the stepper arrow, clicking on a stepper arrow will move the slider box in the indicated direction approximately one line. If the user continues to depress the pointer select function, the image will continue to scroll as indicated.

The user can scroll the image more rapidly by clicking on the scroll bar between the stepper arrow and the slider box. This interaction usually moves the image approximately one page. Additionally, the user may be able to drag the slider box to any position in the scroll bar to rapidly move the image. Once the pointer select button is released, the image will move to the position corresponding to the new slider box position.

When in a scrollable data pane, the user can scroll by dragging the pointer off the image in any of the four directions. The image will incrementally scroll in the indicated direction until the pointer select button is released or the pointer is dragged back into the data pane.

7.7.1.2.2 Scrolling with the Arrow Keys

The scroll bars will form a tab group. By using the TAB function, the user will shift keyboard focus to the scroll bars of the scrollable data pane and allow a scroll function with the arrow keys. When keyboard focus is shifted to the scroll bars, the scroll bars will become visually distinct from inactive scroll bars by bolding or outlining the scroll bar components (see s 7-1 vs. 7-2). The cursor will not be displayed while the system is in the scroll mode.
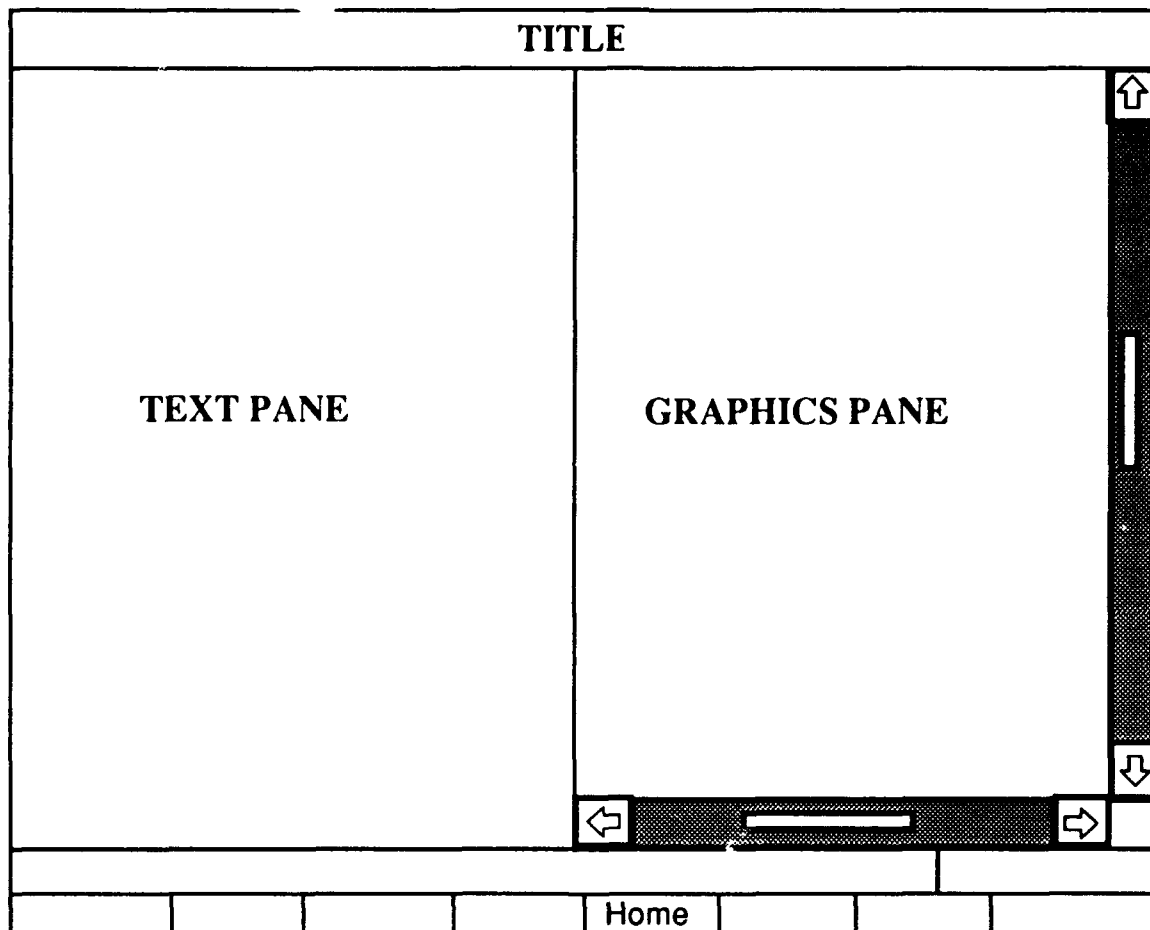
Figure 7-2: Active Scroll Bars

The scroll bars will follow the scrollable data pane they control in the tab group sequence. For example, the user would press TAB to go from the data pane to the scroll bars and press BACKTAB to return to the data pane.

Once the Scroll function is invoked, pressing the appropriate arrow key will move the view of the data in the indicated direction (the slider box will move in the opposite direction of the data). When using the arrow keys to scroll, the stepper arrows will be briefly highlighted to acknowledge each key press.

7.7.1.2.3 Scrolling with the Function Keys

When the user shifts keyboard focus to a scroll bar, the function keys will change from their prior settings to their scrolling settings. By pressing these keys, the user will be able to readily access other manipulation functions while the scroll bar remains selected. At present, the only manipulation function that has been identified is the HOME function.

The HOME function allows the user to return the content of a data pane to its original position. That is, if the user has scrolled a data pane, he/she can return that pane to its original state prior to scrolling by pressing the HOME function.

7.7.2 Unique Requirements for Scrolling Different Data Panes

The following sections describe characteristics unique to scrolling the different data types.

7.7.2.1 Scrolling Text Panes

If the current text is too large to fit in the text pane, the pane will become scrollable. Text will scroll in the vertical direction only.

7.7.2.2 Scrolling Graphic Panes

Whenever a graphic extends over one data pane, the user will be able to scroll the data. Graphics can scroll both horizontally and vertically as described earlier.

7.7.2.3 Scrolling Table Panes

Whenever tables extend over one data pane, the user will be able to scroll the data. Tables may be scrolled vertically and/or horizontally one row/column or one page (view) at a time. As the user scrolls through a large table of data, the column and row headers will remain visible at all times.

7.7.2.4   Scrolling User Prompts

User prompts should be organized so that the user does not have to scroll to input (or view) required data. If a prompt must be scrolled, scrolling will occur in the vertical direction only.

8. TECHNICAL ORDER PRESENTATION SPECIFIC CAPABILITIES

The Technical Order (TO) presentation system has special presentation requirements in addition to the general requirements described in the previous sections of this document. The information detailed in this section includes:

- composite screens,

- procedural information,

- descriptive information,

- parts information, and

- menu bar functions.

8.1 Composite Screens

Every screen in the TO presentation system consists of some combination of text, tables, graphics, dialog boxes, and/or user prompts. This section describes general guidelines for all PMA TO screens and MIW TO windows.

8.1.1 Screen Components

Two features will be employed for all display formats, regardless of composition: appropriate use of blank (or empty) space and consistent location of items on the screen.

Appropriate use of blank space should be implemented so that the eye is guided horizontally and/or vertically through the screen with lines formed through use of blank space (i.e., space in the color of the background) and display elements. To assist in guiding the eye, explicit borders will be drawn between window panes.

8.1.2 Screen Layout

Screen layout for the TO presentation system will follow the guidelines provided in preceding sections of this document. The following sections provide specific guidelines for combining data panes into screens of technical information.

The screen layout rules are used to describe the presentation of data panes for technical information. Special emphasis has been placed on attempting to develop rules

that provide the user with the information he/she needs without requiring extra interaction (i.e., scrolling). The following layout rules assume that each screen has exactly one text pane, and/or one to two graphic (or table) pane(s).

Figure 8-1 shows a series of screen templates which will support the display of technical information. Any data panes in Figure 8-1 can become scrollable.

Text Only

Graphic Only

**One Text with
One Graphic/Table**

**One Text with
Two Graphic/Tables**
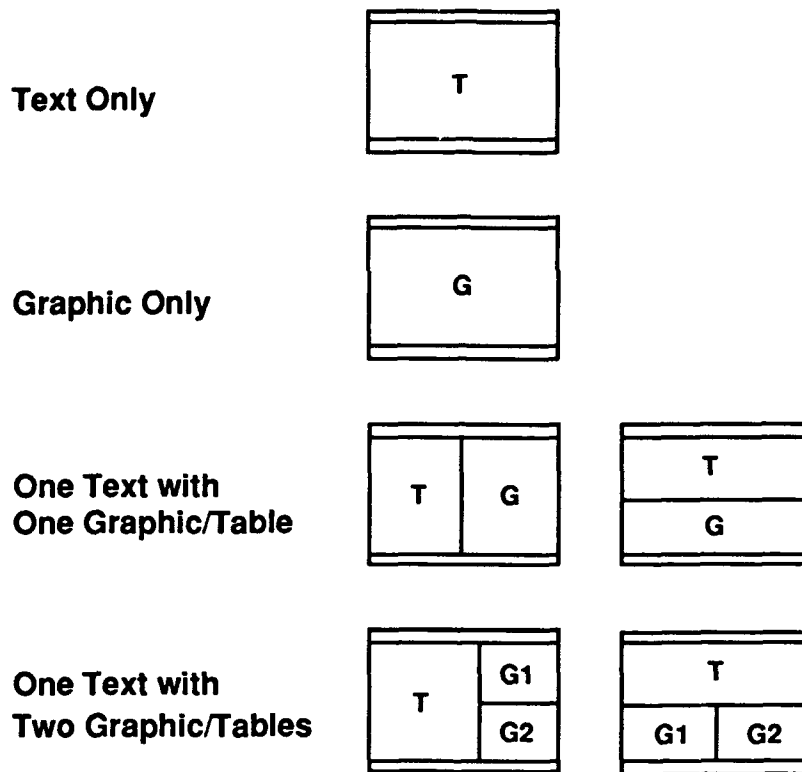
Figure 8-1: Screen Layout Templates

At the minimum font size, text panes should be no less than 30 and no more than 60 characters in width. Text data will always start in the upper-left corner of the screen. If the text at the current size font does not fit within the text pane, the text pane will become scrollable. Exact display characteristics of a scrollable text pane are TBD (depending on whether the autoscroll text pane is used).

Graphic panes should be large enough to satisfy the minimum size specified (in inches) by the author. If this constraint cannot be satisfied and the graphic must be made scrollable, the graphic should be scaled so that the visible image appears at the minimum size intended by the author. By default, the graphic will be centered relative to the scrollable pane (unless position information is available).

8-2

When displaying one text pane and one graphic pane (or table pane), the text and associated graphic should appear on the same screen using one of the two templates in Figure 8-1 (based on the size of data pane content). The presentation system will then size the text pane (30 < width < 60) to accommodate the graphic pane. If the data cannot fit on the screen without scrolling, the graphic pane will be made scrollable. When the graphic pane is made scrollable, the text pane should be minimized to allow presentation of the text without scrolling while displaying as much of the graphic in the visible pane as possible. If both panes must become scrollable, each data pane should take up approximately 50 percent of the screen as depicted in Figure 8-1.

If there are two graphics (G1 and G2) related to the currently displayed text, each graphic will be placed into a separate graphic pa e, such that the minimum constraints for text and graphic panes (as previously described) are maintained. The graphics will be arranged in the same order as they are referenced in the text (from top to bottom or left to right). If the data cannot fit on the screen without scrolling, G1 (or G2) will be made scrollable. When G1 is made scrollable, the text and G2 should be minimized to allow presentation of the text and G2 without scrolling while displaying as much of the graphic in G1 as possible. If both graphic panes must become scrollable, the sizing process will be repeated so that the text is not scrollable. If all three data panes must be scrollable, they should be laid out as depicted in Figure 8-1.

8.2 Procedural Information

Maintenance tasks for the operational level (O-Level) will be presented by displaying the following information

1. An initial text pane which contains the task title and as many of the personnel, equipment, and consumables specified as input conditions that will fit on the screen will be displayed.

2. Subsequent input conditions will be shown by pressing NEXT, as required, to show any remaining personnel, equipment, and consumables specified as input conditions.

3. Any required conditions which are part of input conditions will be displayed.

4.	Any safety conditions (warnings, cautions, or notes) which are linked to the entire task will be shown.

5.	A sequence of steps in data panes presenting all the steps included in the task, along with any graphics and alerts linked to the individual steps, will be displayed.

6.	Any follow-on conditions associated with the task will be presented when the task is complete.

8.2.1 Titles for Procedural Information

The title of the task will appear centered in the Title Bar for all displays related to the current task. The title will not change for the duration of the task.

8.2.2 Input Conditions

In addition to the individual steps for a task, a procedure contains initial setup information which will be displayed prior to displaying the steps. The initial setup lists information the technician must know before starting a task. The input conditions are:

- personnel recommended,

- support equipment,

- supplies (consumables),

- required conditions,

- safety conditions (alerts), and

- other recommendations.

Each subsection of input conditions for a task (i.e., personnel, equipment, consumables, and required conditions) will have an upper-cased, left-justified title and will conclude with a colon. The subsection title will identify the type of information following it. The title will appear on the line immediately preceding the first line of information (see Figure 8-2). If the type of information reflected by the title requires more than the space provided by the available text pane, the information will be

continued in the next frame. In this case, the title will change to "<Data Type>, CONT:" to indicate that the same type of information is being shown.

8.2.2.1   Personnel, Equipment, and Consumables

Personnel, equipment, and consumables will be displayed in succession in the content region (see Figure 8-2). These elements can have single or multiple entries.

```
┌─────────────────────────────────────────────────────────────────────┐
│                    TITLE OF CURRENT TASK                              │
├─────────────────────────────────────────────────────────────────────┤
│                                                                       │
│  INPUT CONDITIONS                                                     │
│                                                                       │
│  PERSONNEL RECOMMENDED:  Two                                          │
│       Technician A - removes xxx                                      │
│       Technician B - assists in removal of xxx                        │
│                                                                       │
│  SUPPORT EQUIPMENT:                                                   │
│       Generator Set - Type A/M 32A-60 or Equivalent                   │
│       Air-Conditioner -  A/M32C-10A or Equivalent                     │
│       Cordage Assembly  -  Part No. 5-62887-1                         │
│                                                                       │
│  SUPPLIES (CONSUMABLES):                                              │
```

NAME	SPECIFICATION	PART NO.	QTY
Safety Wire		MS20995C32	AR
Sealing Compound	MIL-S-83430		AR

Press NEXT to continue							
Next						Back	

Figure 8-2: Procedural Information Title Screen

Personnel information will describe the number of personnel required to perform the task. As a design goal, if two or more technicians are required, a letter designator for each technician (A, B, C, . . . , etc.) will precede a description of his/her role in performing the task.

The equipment information will be presented on successive lines immediately below the subsection title with "NAME" and "TYPE" or "PART NO." separated by a hyphen.

The supplies information will be presented in a table with the following four headers: NAME, SPECIFICATION, PART NO., and QTY.

Supply tables will not scroll. At least two entries should fit on the current input conditions screen. If supply tables cannot fit on the current screen, they will be continued on the next screen and headers will be redrawn. Otherwise, the table will start on the next screen.

Function-key assignments for the personnel, equipment, and supplies screen(s) are not completely defined but should allow the user to (1) order a consumable from supply by selecting the item and (2) request another technician to assist with the task.

8.2.2.2 Required Conditions

As a design goal, the required conditions will be displayed on a screen separate from the other input conditions as a list with a check box preceding the text content of each required condition. Multiple required conditions may be displayed. A filled check box on the line indicates that the condition is satisfied; an empty check box indicates that the condition must be accomplished before the first step of the current task is displayed (see Figure 8-3).

```
┌─────────────────────────────────────────────────────────────┐
│              TITLE OF CURRENT TASK                          │
├─────────────────────────────────────────────────────────────┤
│                                                             │
│  REQUIRED CONDITIONS:                                       │
│                                                             │
│      ▨   Aircraft Safe for Maintenance                      │
│      □  ┌─────────────────────────┐                         │
│         │ Open Access Door 111    │                         │
│         └─────────────────────────┘                         │
│      ▨   Turn Off Electrical Power                          │
│                                                             │
│                                                             │
│                                                             │
│                                                             │
│                                                             │
│                                                             │
│                                                             │
│                                                             │
│                                                             │
│                                                             │
│                                                             │
├───────────────────────────────────────────────┬───────────┤
│  Access or  Check-Off Required Conditions.      │           │
├──────┬────────┬──────────┬────────┬──────┬──────┼────┬──────┤
│      │ Access │Completed │        │      │      │Back│      │
└──────┴────────┴──────────┴────────┴──────┴──────┴────┴──────┘
```

Figure 8-3: Required Conditions

As many required conditions as possible will be displayed within the content region. Each required condition will be visually distinct from other required conditions.

When the required conditions are presented to the user, the cursor will appear where user input is required (on the text of the first unsatisfied condition). The unsatisfied conditions can be responded to by the user in the order in which they are presented. As the user responds to a condition, it will be checked off and the cursor will move to the next unsatisfied condition. However, the user can move the cursor on the text of any condition and use the function keys to access the associated procedure.

For each unsatisfied condition, the user has two options: (1) access data to perform the procedure using the ACCESS function or (2) indicate that the actions necessary to meet the required condition have been completed by using the COMPLETED function. These functions, the two left-most ones, can be selected by pressing the function key. Required conditions without linked procedural information

(e.g., wind velocity less than than 15 knots) will not have the ACCESS function available.

If the user selects ACCESS, the steps for meeting the condition will be presented. The user will proceed through these procedural nodes as described in this section. Once the user completes the last node, pressing NEXT will return him/her to the display of required conditions, cause the condition to be checked off, and highlight the next unsatisfied condition.

If the user selects COMPLETED, the required condition will be checked off and the next unsatisfied condition will be highlighted.

The user will be able to uncheck a required condition by placing the pointer over its check box and pressing SELECT. At this point, the user can proceed with that one condition as described above.
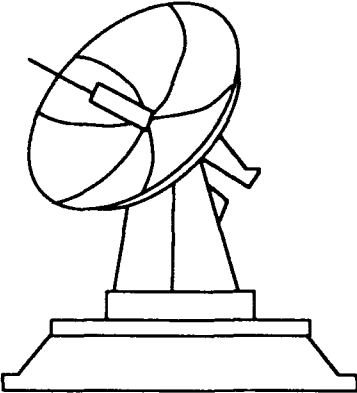
The message line at the bottom of the screen will display the instructions, "Use ACCESS and COMPLETED to check-off Required Conditions," until all required conditions have been checked off. After all required conditions have been checked off, the message line will display "Press NEXT to begin task steps."

Function-key assignments during required condition screens will be Access, Completed, and Back. "Next" will be displayed after all required conditions are complete.

8.2.3 Presentation of Steps

Prior to entering the steps of a procedure, the user will be presented with any alerts (Warnings, Cautions, or Notes) which are linked to the entire task. Additionally, any alerts linked to a step will be overlaid on the step. The display characteristics of alerts are described later in this section.

Multiple steps will be displayed, if possible. There will be one blank line between each step. Only the last step on the screen will be active. The active step will be displayed in a bold font to differentiate it from previous steps (see Figure 8-4).

REMOVAL OF BULKHEAD COVERS AND ANTENNA PEDESTAL COVERS	
(A) Remove six screws and six washers from antenna pedestal covers. (A,B) Remove right and left antenna pedestal covers as one unit. (A) Remove screw and washers from lower antenna pedestal covers. (A,B) Remove lower antenna pedestal cover. (A,B) Remove antenna feed horn. (A) Center antenna pedestal.	
MESSAGE LINE	**ICON AREA**

Figure 8-4 : Procedural Steps

If multiple steps are displayed, the text of the active step must fit within the text pane, and the graphic(s) associated with the current step must be displayed per the layout rules described earlier in this document. If a step requires a different base graphic, all previous steps will be removed from the screen.

For tasks requiring multiple technicians, a symbol which assigns tasks to technicians will be displayed in parentheses prior to the beginning of the step (e.g., (A,B)).

The function-key assignments during the display of procedural steps will be Next, Locator, IPB, Theory, and Back. The More/Less function will be available for authorized users.

8.2.3.1   Referenced Tasks

Often a task references another task or subtask in technical data. The presentation system will display the title of the referenced task as another step in the current task. The display of the referenced task title will be visually distinct from normal steps. The status

of the task (completed or uncompleted) will be indicated by a check box. Interaction with the referenced tasks will be similar to that of required conditions (see Section 8.2.2.2) in that, the user will have the option of viewing or by-passing the referenced task. The message line will display, "Use ACCESS or COMPLETED to check off the task."

The function-key assignments during the display of procedural subtasks will be Access, Completed, and Back.

8.2.3.2   User Prompts

Graphical selection methods, function keys, and/or number keys will be used when soliciting input from the user during the presentation of procedural information; these are called prompts. Prompts will be presented in a dialog box overlaying the text pane. The presentation system will attempt to display the dialog box where the text of the next step would have appeared (directly below the previous step). However, the dialog box border will not extend beyond the content region.

The dialog box will contain the text of the step and prompt along with the dialog controls for answering the prompt (radio buttons, check boxes, fill-ins, or selection lists). Interaction with dialog box controls is described in Section 6.

The presentation system will display the contents of the text component in the title area of the dialog box.

The type of dialog box control used to interact with a prompt depends on the contents of the dialog element in the data base. The following paragraphs describe rules for presenting the various types of dialogs displayed with a prompt.

Dialogs authored as menus can be either single or multiple choice. Single-choice menus can be presented as either radio buttons or dialog-box push buttons. Dialog-box push buttons are preferred for simple yes/no questions because the interaction requires only one keystroke. After pressing one of the soft-function keys to answer the prompt, the system will display the next step. If the menu choices are displayed as radio buttons, the user must select one then acknowledge the selection by choosing the dialog-box push button.

Multiple choice menus will be displayed as check boxes.

Dialogs authored as fill-ins will be displayed as fill-ins.

Dialogs authored as selections will be displayed with the prompt, graphic, and/or table in a dialog box.

Any dialogs authored as multiple fill-ins and/or more than one menu or selection will be displayed in a composite dialog box. Interaction with composite dialog boxes is described in Section 6.

If a default value is authored in the prompt, the default selection will be indicated.

Once the user has made one or more selections, he/she will confirm those choices and proceed by pressing Next. The prompt will be embedded in the text as the next step is displayed.

Function-key assignments for prompt dialog boxes will be Next and Back unless the function keys are mapped to choices. The instructions for all prompts will be "Select your choice(s) and press Next" or "Use Yes or No to answer the question," depending on the type of prompt.

8.2.3.3 Novice/Expert Tracks

While presenting procedural data, the TO presentation system will provide a choice of two tracks of detail to the technician: the novice track and the expert track. The novice track will contain all the standard information contained in technical manuals. The expert track will resemble a check list, presenting only the steps required to complete a task. Both tracks will contain all pertinent safety information. The expert user will have the ability to access information at the novice track, but the novice will not be able to access the expert track. The presentation of expert/novice tracks is TBD.

8.2.4 Follow-On Conditions

Follow-on conditions (actions which must be completed to return the aircraft to its original configuration) will be displayed at the end of the task. These conditions will be displayed on the follow-on maintenance data pane which is displayed after the last step of a task. The follow-on maintenance screen will appear similar to the required conditions screen. That is, each follow-on condition will be displayed as a list of items to be checked off (see Figure 8-5). If the condition was satisfied during the course of the procedure, the check box will initially be checked. Likewise, after the condition is satisfied, the check box will be checked.

```
┌─────────────────────────────────────────────────────────────┐
│                  TITLE OF CURRENT TASK                      │
├─────────────────────────────────────────────────────────────┤
│                                                             │
│  FOLLOW-ON MAINTENANCE:                                     │
│                                                             │
│    ▨  Perform Operational Check-Out of Component xxx        │
│    ☐ │Close Access Door 111        │                       │
│    ▨  Close Access Door 112                                 │
│                                                             │
│                                                             │
│                                                             │
│                                                             │
│                                                             │
│                                                             │
│                                                             │
├──────────────────────────────────────────────┬─────────────┤
│ Access or Check-Off Conditions or Press Next to End Task │   │
├──────┬────────┬─────────┬──────┬──────┬──────┼──────┬─────┤
│ Next │ Access │Completed│      │      │      │ Back │     │
└──────┴────────┴─────────┴──────┴──────┴──────┴──────┴─────┘
```

Figure 8-5: Follow-On Conditions

The presentation system will track all open follow-on conditions and display them to the technician before quitting the session. The system will also present any global follow-on condition which may exist. However, even while quitting a TO presentation system session, the technician has the option not to accomplish the follow-on maintenance. These incomplete maintenance tasks will be recorded by the system.

Function-key assignments during follow-on conditions will be the same as those for required conditions.

8.2.5 Navigation and Other IMIS Functions in Procedural Information

The TO presentation system uses a subset of the functions available for all IMIS applications. The following sections further define the application of IMIS functions in procedural technical data.

8.2.5.1   NEXT

The NEXT key will be the primary function for progressing through Type C procedural information. NEXT presents the next logical node of information (e.g., step or paragraph). Additionally, NEXT is used to acknowledge the completion of a data entry screen, prompt, or dialog, and proceed to the next node.

When progressing through procedural steps, the system sets internal variables which correspond to the state of the aircraft. By pressing NEXT, the user tells the system that a step has been completed and the system sets any variables associated with that step to their postcondition states.

8.2.5.2   BACK

The back function allows the user to move backwards through procedural data. The back function is not a retrace function in that only one physical visit to a node will be accessed through the BACK function. Upon pressing BACK, all system variables will be reset and a description of what was reset will be displayed on the message line. Additionally, BACK will reset all prompts to their initial or default states.

This section discusses the use of BACK in the Presentation of Type C procedural information. Prior discussions allowed for two modes of operations: perform and review. This has been altered and only the perform mode exists as discussed in the following sections.

Assumptions:

The user has not performed the step currently displayed on the screen.

Usages:

When the user depresses the BACK key, the Presentation system will return to the previously displayed node (step, higher IPB level, etc.) and perform the following actions (when appropriate):

- alter the state table (for procedural data only),

- prompt the user in the message line on how to "undo" a step (for procedural data only), and

- indicate to the user what the state table feels will be the active value for an attribute (for procedural data only).

State Table:

If a step asserts a value for an attribute to the state table, BACK will alter the state table according to the attribute class. Currently, three classes of attributes have been identified:

- binary - attributes that have two possible values (e.g., on/off, open/close).

- list - an attribute that requires a message be sent to the user upon pressing the BACK key (e.g., a switch)-this allows the user to "undo" their maintenance action; and

- prompted - an attribute that requires a message be sent to the user upon pressing the NEXT key to return from BACK. This allows the user to know what was previously entered and be able to simply press NEXT to accept the prompted response.

Example:

The following is an example of how the state table could be used with the BACK function. Application Programmers Interface (API) commands will be used to update the state table.

STEP	API Command	Current State	Altered State
Open Panel Door 5	(door5, open)	(door5, closed)	(door5,open)
Remove Connector J3	(conJ3, discon)	no entry	(conJ3,discon)
Set Switch 5 to X	(sw5, X)	(sw5, (Y))	(sw5,(Y,X))
Measure Volt on Pin 2	(J3P2, 4.2)	(J3P2, 4.2)	(J3P2,(2,(*,4.2)))

(New Step)

At this point the user presses the BACK key, the state table is changed to two, and a message prompt is displayed stating, "BACK has been selected. J3P2 value is set to 2."

Additionally, the value of 4.2 is retained but not as the active value which is indicated by the asterisk (*).

Open Panel Door 5	(door5,open)
Remove Connector J3	(conJ3,discon)
Set switch 5 to x	(sw5,(Y,X))
Measure Volt on Pin 2 (J3P2,BACK	(J3P2,(2,(*,4.2))) (J3P2,((*,2),4.2))

When BACK is pressed again, the state table changes to "Y" and the message prompt, "BACK has been selected, SW5 is set to Y" is displayed. This message tells the user that SW5 was in the "Y" position prior to complying with this step. The state table assumes that the user will set SW5 to "Y."

Open Panel Door	(door5,open)
Remove Connector J3	(conJ3,discon)
Set Switch 5 to X	(sw5,BACK)(sw5, (Y,X)(sw5,(Y))
Measure Volt on Pin 2	(J3P2, ((*,2) ,4.2))

When BACK is pressed again, the state table changes to indicate that the connector is connected and the message prompt, "BACK has been selected, CONJ3 is set to con" is displayed. The state table assumes the user will connect the connector.

Open Panel Door 5	(door5,open)
Remove Connector J3	(conJ3,BACK)(conJ3,discon)(conJ3,con)
Set Switch 5 to X	(sw5,(Y))
Measure Volt on Pin 2	(J3P2, ((*,2),4.2)

NEXT is now pressed. This means the current step has been completed and the connector has been removed. The state table is set to show that the connector has been removed when the user presses NEXT. At this point, the user is now preceding normally and complying with the state being presented.

Open Panel Door 5	(door5,open)
Remove Connector J3	(conJ3,discon)(conJ3,con)(conJ3,discon)
Set Switch 5 to X	(sw5,(Y))

Measure Volt on Pin 2	(J3P2,((*,2),4.2))

NEXT is again pressed. This means the current step has been completed and the switch has been set to "X." The state table is set to show that SW5 has been set to "X" when the user presses NEXT.

Open Panel Door 5	(door5,open)
Remove Connector J3	(conJ3,discon)
Set Switch 5 to X	(sw5,X)(sw5,(Y))(sw5,(Y,X))
Measure Volt on Pin 2	(J3P2,((*,2),4.2))

The user is again prompted to measure voltage. Once again, NEXT is pressed. This means the voltage reading was made again or the user wants to look at the value that was retained by the current step. A dialog appears with the measurement of 4.2 already filled in. If the user presses NEXT, 4.2 is accepted and becomes the active value or a new value; otherwise, could be entered at this time.

Open Panel Door 5	(door5,open)
Remove Connector J3	(conJ3,discon)
Set Switch 5 to X	(sw5,X)(sw5,(Y))(sw5,(Y,X))
Measure Volt on Pin 2	(J3P2,PROMPT)(J3P2,((*,2),4.2))(J3P2,(2,(*,4.2)))

8.2.5.3 Supplemental Information

When the Supp Info function is invoked in procedural information, the supplemental mode is entered and all text and graphic components in the active step with cross-referenced information will be outlined. All outlined items become selectable as described in Sections 4 and 7.

8.2.5.4 Locator

The Locator function will behave as described in the menu bar; that is, a locator diagram for the current step will be displayed. A description of the behavior of locator diagrams is contained in the Descriptive Information portion of this section.

8.2.5.5   IPB and Theory

IPB and Theory functions will behave as described in the menu bar; that is, when either function is invoked, a pop-up menu will appear with an option of obtaining information on the current system or step. A description of the behavior of IPB and Theory nodes is contained in the Parts and Descriptive Information sections of this document.

8.2.6 Alerts and System Notification Messages

Alerts are precautionary messages that are displayed as Warnings, Cautions, and Notes associated with TO data. Alerts will be given individual characteristics (e.g., different icons, highlighting, line widths, etc.) to ensure easy recognition of each one. Tasks can have alerts as part of the input conditions; steps can also have related alerts. Each alert is linked to an icon which identifies the type of alert.

System notification messages are messages to the user concerning a system condition that could (or has) negatively impact current system processing. System notification messages differ from system messages on the message line in that message line items do not alert the user to a system condition; rather, they supply guidance for interaction with the system. System notification messages can appear at any time and are system-generated.

Alerts and system messages will be presented in a pop-up dialog box in the center of the display window and will precede the text or procedural steps to which they apply. A note may either precede or follow the step to which it pertains.

If multiple alerts are linked to the same node, they will be displayed <u>one at a time and must be acknowledged before the node becomes active</u>. The order of presentation for multiple alerts will be warnings, cautions, and, finally, notes.

An icon will be placed with the alert so that the icon can remain in the lower-right corner of the screen through all steps to which the alert applies. Alert icons will appear in the icon area in a consistent location. The user can select the icon to redisplay the full description of the alert. If multiple alerts are related to the icon (e.g., three warnings), they will be displayed in overlapping dialog boxes with the most recent alert on top.

Alerts may have an associated hazard icon. Hazard icons will be used to provide a graphic depiction of the potential hazard. For an example of hazard icons and descriptions, see Figure 8-6. If a hazard icon is used in addition to the warning icon, the icon which appears in the icon area will be the standard warning icon (inverted triangle) NOT the hazard icon.
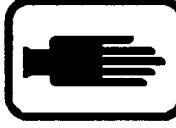
ICON	DESCRIPTION	ICON	DESCRIPTION
	Eye Hazard		Skin Hazard
	Corrosive		Poison
	Breathing Hazard		Radiation
	Explosion Hazard		Cryogenic
	Fire Hazard		Oxidizer
	Ingestion Hazard		Biohazard

Figure 8-6: Hazard Icon Descriptions

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All alerts and system messages will be presented in a dialog-type box with a double line surrounding it. Specific layout guidelines are described below.

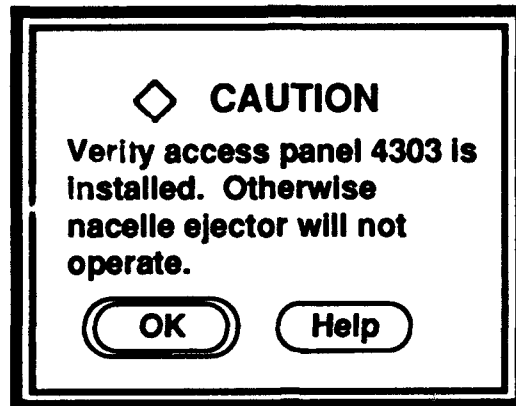- Warning. The warning alert will have a wide black box around the text. This box will be surrounded by a wide "white" (background color) box, which will be surrounded by a wide black box. The space between the two black boxes will be occupied by 45 degree (off the horizontal plane) slashes. The slashes will alternate wide black and wide "white" bands. A warning icon (the standard inverted triangle) will be displayed followed by two "spaces" and the title "WARNING"; these two items will be centered in the window. The title will be in the title font identified earlier in this document. A hazard icon will then be centered below these items as shown in Figure 8-7.

Figure 8-7: Warning Alert

- Caution. The caution alert will have a wide black box surrounding the text. This box will be surrounded by a wide "white" (background color) box, which will be surrounded by a wide black box. A caution icon will be displayed followed by two "spaces" and the title, "CAUTION"; these two items will be centered in the window. The title will be in the title font identified earlier in this document (see Figure 8-8).

Figure 8-8: Caution Alert

• Note. The note alert will have a medium-wide black box surrounding the text. This box will be surrounded by a wide "white" (background color) box, which will be surrounded by a two-pixel-wide black box. A note icon will be displayed followed by two "spaces" and the title, "NOTE"; these two items will be centered in the window. The title will be in the title font identified earlier in this document (see Figure 8-9).
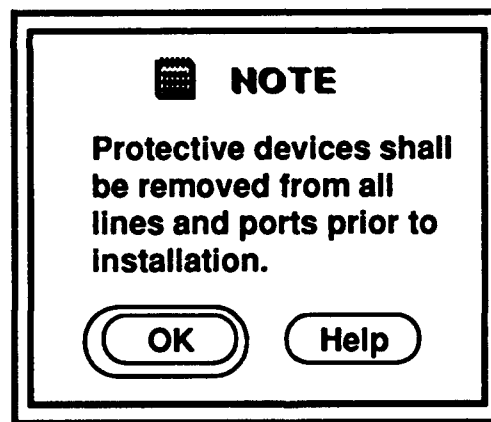
Figure 8-9: Note Alert

• System Message. The system message will have a visually distinct border surrounding the text. The title, "MESSAGE," will be centered in the window and will be in the title font identified earlier in this document (see Figure 8-10).

Figure 8-10: System Message

8.2.7 Interactive Electronic Technical Manual Changes

As technical information is updated, the technician must be notified of the changes. The TO presentation system will provide visual markings on nodes of information to identify updated data. The exact presentation of changed information is TBD.

8.3 Descriptive Information

Descriptive information is nonprocedural. This type of information will be available through the Supp Info function, the menu bar, and/or soft-function keys. Descriptive information provides the user with background and supporting information which may be necessary for performing certain tasks. Theory of operations, physical arrangement diagrams, and schematic and wiring diagrams are examples of descriptive information which might be accessible to the user.

8.3.1 Theory of Operation

Theory information is composed of text and/or graphics. The layout for this type of information will be node by node. Pressing NEXT will present the next node. The technician will be able to access theory of operation through menu selection. When in theory of operation, the user will be able to return to the previous thread at the end of the informational sequence by pressing Return.

Theory information will have a "table of contents" menu consisting of the heading names for the main sections (e.g., Description, Function, etc.) of the node of theory for

the selected system. This menu will provide easy access to the section of theory needed for the job.

The message line will display, "Press NEXT for more Theory." When on the last screen of a theory node, the message line will display, "Press NEXT to exit Theory."

The soft-function key assignments during theory of operation will include NEXT TOC, Locator, IPB, BACK, and Return.

8.3.2 Diagrams

The system will provide a variety of graphical information which, in conventional technical manuals, is provided as fold-out pages referenced from procedural information. Diagrams will be displayed as specified in the Data Panes section of this document (Section 7).

If there are multiple levels of diagrams related to the one currently displayed, the user will be able to access these. Portions of the diagram for which there are other levels will have selectable call-outs. To move to another level, the user will highlight the appropriate call-out and press SELECT. A pop-up menu will appear, providing options to move to a lower or higher level of the diagram. To leave the diagram, the user would press the Exit soft-function key.

8.3.2.1 Schematic and Wiring Diagrams

When information must be presented via a signal flow chart or circuit diagram, visual aids will be divided into discrete units, simplified and standardized to the greatest extent possible to adapt to the limitations of an electronic display system. Exact display characteristics of these diagrams depend on the type and are TBD.

Where possible, schematic and wiring diagrams will contain only the information referenced by the text with which they are displayed.

The following soft-function keys will be available for use in a diagram: Locator, IPB, Search, Theory, and Return.

8.3.2.2 Functional Flow Diagrams and Block Diagrams

Functional flow and block diagrams shall be drawn as flow charts indicating the direction of system interaction. If possible, the diagram shall contain only the detail referenced by the accompanying text. Exact display characteristics of these diagrams depend on the type and are TBD.

8.3.2.3 Locator Diagrams

Locator diagrams are special-purpose graphics to aid the user in locating a major equipment unit in reference to its surroundings. A locator diagram shall contain a labeled graphic together with required call-outs and will appear in the graphics pane, overlaying the current graphic associated with the text. The locator diagram will be surrounded by a visually distinct border in order to differentiate it from any other graphic appearing in the graphic pane. The locator diagram shall show what a particular item looks like, and demonstrate its relationship to its surroundings (equipment unit). Only one locator diagram will be presented at a time. The user will be able to select lower- and higher-level locator diagrams as described for IPBs in Section 8.5. The message line will then display, "Select a call-out to change level of view" in a locator diagram.

The following soft-function keys will be available for use in a locator diagram: IPB, Search, Theory, and Return.

8.4 Parts Information

The system will incorporate all required supporting information which, in conventional technical manuals, has usually been included in a separate IPB.

In general, the IPB should be designed to permit unambiguous identification of all replaceable or repairable parts, show precisely the physical relationship of the target part to other parts of the system, and provide to the technician all nomenclature data required to order the part (e.g., catalog number, stock number, supplier number, and part name) that is currently contained in a conventional paper-based IPB. IPBs will illustrate each part using line drawings and will show its physical relationship to adjacent parts.

Display of parts information will follow guidelines established in the Data Panes section of this document (Section 7).

IPBs can be accessed in a variety of ways. If the user selects the IPB step or system option from the menu, a list of available IPBs will be displayed within a dialog box and the user will select the desired IPB. The user may also select an IPB from the pop-up menu associated with a part in a procedural information node having supplemental information. Accessing supplemental information is described in Section 4.

The whole content region will be used to display the IPB. The IPB will contain a graphic and call-outs to portions of the graphic for which there is more information. An example of a basic IPB display appears in Figure 8-11.
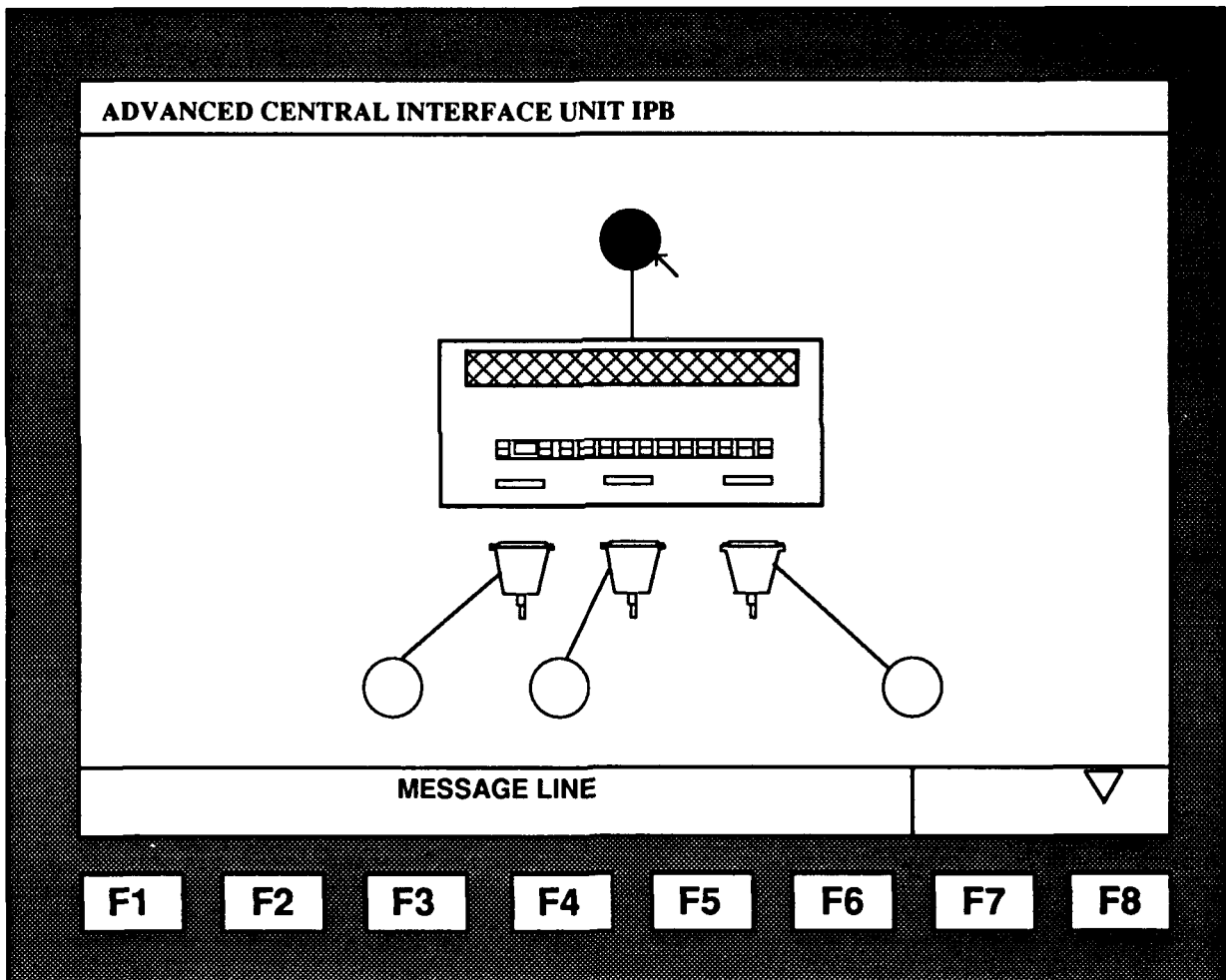
Figure 8-11: Illustrated Parts Breakdown

Once the IPB has been displayed, the user will be able to access parts information for any IPB component for which there is a call-out. To do so, the user will select the

call-out. A pop-up menu will then be displayed with options to obtain detailed parts information and view higher or lower assemblies, if available.

Detailed parts information will be displayed in a dialog box (see Figure 8-12). The dialog box containing parts information will try to not obscure the component to which it pertains. Each selectable component will have the following parts information, if available: Part Number, National Stock Number (NSN), WUC, Federal Stock Control Number (FSCN), and Units per Assembly.

ADVANCED CENTRAL INTERFACE UNIT IPB

NOMENCLATURE: CENTRAL INTERFACE UNIT
PART NUMBER: 950410-301
NSN: 5841-01-890-5953
WWC: 72ADO
USABLE ON CODE: A
FSCN: 81755
UNITS PER ASSY: 1

OK   Save to Parts List   Supply

MESSAGE LINE

F1   F2   F3   F4   F5   F6   F7   F8
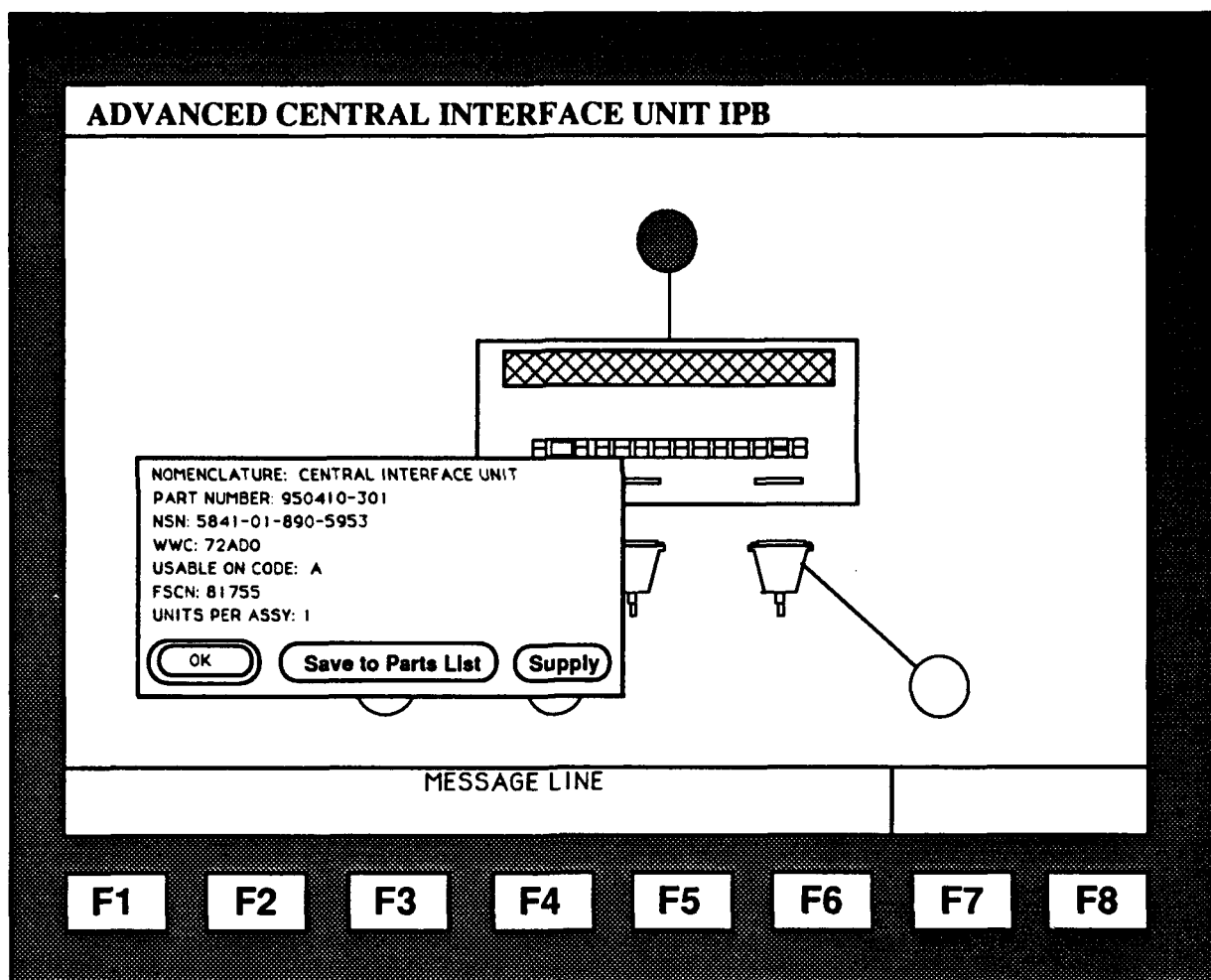
Figure 8-12: Detailed Part Information

For each selectable component in the IPB, there may be a higher- or lower-level view of the IPB available for review. If either view is not available for the selected call-out, the option will not be provided on the pop-up menu. When accessing either higher or lower levels of an IPB, pressing BACK will take the user to the previous view. To

leave the IPB displays, the user would press the Return soft-function key. The message line will then display, "Select a call-out to obtain part info or change view."

The following soft-function keys will be available for use in an IPB: Locator, Search, Theory, and Return.

When the detailed parts information is displayed, the soft-function keys will be OK, Save, and Supply. OK will be defaulted to NEXT (see Figure 8-12).

8.5 Menu Bar

The TO presentation system is supported by both the TO presentation module and IMIS executive functions. Until the services provided from IMIS are defined, the exact menu bar cannot be fully defined. The technician will interact with the menu bar as described in Section 5.

When the user is in the Menu Bar Environment, all the functions available through the system will be listed in the menu items on the menu bar, and will be accessible to the user at any time. When the maintenance technician presses the MENU key, he/she is forwarded to the menu bar which replaces the title bar. Pressing the MENU key again will result in the title being redisplayed.

8.5.1 Main Menu Options

Preliminary names and groupings of menu bar options and functions supplied by the TO presentation module have been defined as Navigation, Bookmark/Memo, Status, Utilities, Personal, and Help.

8.5.1.1 Navigation

The Navigation functions can be thought of as capabilities which permit the display of electronic TO text and graphics, and provide the user with a means to identify and quickly access items of information which will assist him/her in performing fault isolation, remove and replace, and repair procedures.

Locate Graphic

This selection has two options.

Step - This displays the locator on the active step.

System - This displays the system locator.

IPB

This selection has two options.

Step - This displays the IPB on the active step.

System - This displays the system IPB.

Theory of Operation

This selection has two options.

Step - This displays the theory of operation for the active step.

System - This displays the system theory of operation.

Procedures

This selection has two options.

Referenced Tasks - This lists all tasks that can be referenced by the current task.

Available Tasks - This option displays a hierarchical list of aircraft systems and subsystems. After the user selects a subsystem, the system displays a list of available tasks for the selected subsystem.

Miscellaneous Data

This selection has three options.

Step - This displays miscellaneous data for the active step.

System - This displays miscellaneous data for the system.

Supplemental Information - This engages the Supp Info function which toggles between showing and hiding available selections. The default is to hide the available selections.

<u>Quit Session</u>

This option allows the user to end the maintenance session.

8.5.1.2 Bookmark/Memo

This function allows the user to create a memo or bookmark.

<u>Memo</u>

This selection allows the user to create, edit, remove, and review memos. Memos are described in detail in Section 8.5.2.

<u>Bookmark</u>

This selection allows the user to create, edit, remove, and go to bookmarks. Bookmarks are described in detail in Section 8.5.3.

8.5.1.3   Status

This feature will be supplied by the IMIS executive.

8.5.1.4   Utilities

The following are special Utilities the user can invoke.

Error - This option causes the current screen to be tagged as discrepant. When the PMA is uploaded to the Maintenance Workstation, a message will be displayed that this step has been tagged for a possible Air Force Technical Order (AFTO) Form 22 TO Discrepancy Report.

Administration - This is an IMIS-determined function.

Display Fault Tree - This option will display a window containing a graphical representation of the fault tree being followed. The utility is designed to aid the user when it appears that a maintenance effort is getting off track or produces an incorrect result. This utility will aid the user by allowing him/her to review what has been accomplished so far in the maintenance activity in order to determine the need for backtracking. Scrolling, navigation, and interaction associated with this data has not yet been defined.

8.5.1.5 Personal

The Personal function gives the user some display options, such as the following.

Detail - Allows Expert users to specify expert or novice track.

Preferences (IMIS-determined) - Allows the user to select display options such as font size, scroll distance, or pointer movement resolution.

8.5.1.6 Help

The Help function will assist the user during operation. The following are a preliminary list of the functions.

Acronyms - This displays a list of all acronyms which may appear in the system.

Key Definitions - A definition of the hard-function keys will be displayed in a dialog box.

8.5.2 Memo

The Memo function will allow the user to create reminders which pertain to specific nodes or a packet. When there is a memo attached to a node, the memo icon will be displayed. Memos are made up of a title (for referencing) and the body of the memo.

The memo function calls up a list of current memo titles from which to select. This list is presented in a dialog box, and the user interacts with the list as described in Sections 5 and 6. The push buttons (and associated function keys) which appear in the dialog box include CREATE, EDIT, and REMOVE (as well as CANCEL which is used to leave the dialog box). After selecting an item from the list (or in the case of CREATE, not selecting a list item), these push buttons are used by the technician as described in the following paragraphs.

8.5.2.1 Creating a Memo

To create a Memo, the user does not select an item from the list, but presses (or SELECTS) the CREATE push button. A fill-in dialog box is displayed with title and memo fields. The cursor will initially be located on the memo title field. In the PMA, the software-generated keyboard will be displayed upon user request (pressing the keyboard function key).

In the PMA, the user will typically use the software keyboard to enter the memo title (as described in Section 6). Once the title has been completed, the user presses the OK key and the entry is displayed in the title fill-in. The cursor then moves to the memo fill-in. When finished entering the memo fill-in, the user presses Save to save the memo, close the dialog box, and progress or return to the next logical node.

Memos can be entered using the QWERTY keyboard instead of the software keyboard.

8.5.2.2 Editing a Memo

To edit an existing memo, the user will select a title from the memo list and press the edit push button. A fill-in dialog box will be displayed with title and memo fill-ins. The cursor will initially be at the memo-title input field. The user can activate the software keyboard by pressing the keyboard function. While editing a memo, the user can press Cancel to clear all memo entries and return to the memo dialog box.

The user can edit a memo in the MIW by typing on the keyboard in addition to using the arrow and select keys.

8.5.2.3 Removing a Memo

To remove a memo, the user will select a memo title from the list and press the REMOVE button. A confirmation dialog box will appear asking the user to confirm the deletion by selecting YES or NO. YES is a soft-function key and will confirm the deletion. NO will close the dialog box and take no action, returning the user to the memo dialog box.

8.5.2.4 Reviewing a Memo

To review a memo attached to an active node, the user would select the memo icon by switching input focus to the icon region using TAB or by moving the pointer via the pointing device and then selecting the icon. The memo associated with that node is displayed in the memo dialog box. If the user wishes to look at a memo not associated with the active node, the user would press MENU, then MEMO, and then choose the title of the memo to be reviewed. Once the cursor is located on the desired memo title, the user can press SELECT twice or press the review push button to go to the selected memo. The memo associated with that title is displayed in a dialog box.

While reviewing the memo, the user has the option to remove or edit the memo by pressing the Remove or Edit push buttons (soft keys). Remove will delete the memo, as described earlier, and retu ⁻ᵢ to the menu bar (or active node); Edit will place the memo in a fill-in dialog box as described for Edit; and CANCEL will return the user to to the menu bar (or active node).

8.5.3 Bookmark

The Bookmark function calls up a list of current bookmark titles from which to select. This list is presented in a dialog box and the user interacts with the list as described in Section 6. The push buttons (and associated function keys) which appear in the dialog box include Create, Edit, Remove, and GoTo (as well as Cancel which is used to leave the dialog box). After selecting an item from the list (or in the case of Create, not selecting a list item), these push buttons are used by the technician as described in the following paragraphs.

8.5.3.1 Creating a Bookmark

This function allows the user to create a bookmark at the current node of information. To create a bookmark, the user would select the CREATE push button. A dialog box is displayed with a bookmark title fill-in. The user can activate the software keyboard by pressing the Keyboard function.

Once the user has completed the bookmark title, he/she will press Save to save the bookmark, close the dialog box, and progress to the next logical node. The user can also press CANCEL to erase all input, close the dialog box, and return to the Bookmark dialog box.

The user can create a bookmark title in the MIW by using the QWERTY keyboard.

8.5.3.2 Editing a Bookmark Title

This function allows a user to edit an existing bookmark. To edit a bookmark title, the user will select a title from the bookmark title list. The user then selects the EDIT push button. A dialog box is displayed with a bookmark title fill-in. The user can activate the software keyboard by pressing the Keyboard function.

Once the user has finished editing the bookmark title, he/she will press Save to save the bookmark, close the dialog box, and progress to the next logical node. The user can also press CANCEL to erase all input, close the dialog box, and return the user to the Bookmark dialog box.

The user can edit a bookmark in the MIW by typing on the keyboard in addition to using the software keyboard.

8.5.3.3   Removing a Bookmark

This function allows the user to remove a previously created bookmark. To remove a bookmark, the user will press MENU and choose BOOKMARK. The bookmark dialog box is displayed and the user will select the title of the bookmark to be removed. The user will then select the REMOVE push button. A confirmation dialog box will appear asking the user to confirm the deletion by selecting YES or NO. YES is a soft-function key and will confirm the deletion; NO will close the dialog box, take no action, and return the user to the bookmark dialog box.

8.5.3.4   Going to a Bookmark

This function allows the user to go to the node in which the selected bookmark was set. To go to a bookmark, the user will select the bookmark title twice (first time to select; second time to "go to") or press SELECT once and press the Go To push button. The user is then taken to the display (node) where that bookmark is stored. The user can press the CANCEL key to return to the active node.

In procedural information, NEXT is not active when the current bookmarked node is displayed. For all other types of information, the user can navigate through the data as described throughout this document.

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APPENDIX A
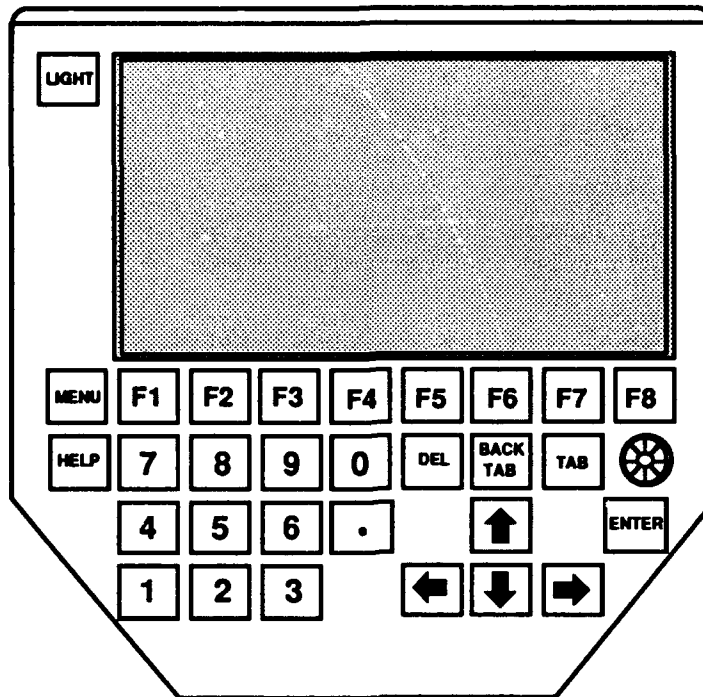# PORTABLE MAINTENANCE AID KEYPAD CHANGE

Based on user feedback during informal demonstrations and during the Integrated Maintenance Information System (IMIS) F-18 demonstrations, Armstrong Laboratory, Logistics Research Division (AL/HRG) is requesting a change to the Portable Maintenance Aid (PMA) keypad layout. A letter was sent to General Dynamics Electronics Division (GDE) requesting the change. At press time, this change was being negotiated and had not yet been approved for implementation.

The change will affect the user interface software. The Enter key will be used for menu selections, form completion, and dialog completion (if mapped to the OK push button). The select key will be a programmable soft-function key used for toggling on/off polychoice lists (check boxes) and to choose hierarchical lists (such as in a list box). Single-choice lists (radio buttons) will be autoselect, thereby eliminating the need for a select function for single choices. In MOTIF, the space bar is often mapped to the Select function on a standard keyboard.

A majority of the IMIS screens (including Interactive Electronic Technical Manuals [IETMs]) do not have polychoice lists or hierarchical lists. Therefore, the select function will seldom be used. Enter (or F1, OK) will be the key used for most completion interactions.

The current PMA function-key assignments are depicted in Figure A-1. The only change from the keypad contained in the Human Computer Interface Specification (HCIS) is that the Select key will be changed to Enter.

Figure A-1: Updated Portable Maintenance Aid Keypad Layout

APPENDIX B
USER INTERFACE DESIGN ISSUES

This appendix documents the user interface design issues that remained open at the time the Human Computer Interface Specification (HCIS) was baselined. These issues only apply to Sections 1 through 7. For a list of the open issues associated with Section 8, see Appendix C.

GENERAL ISSUES

Monochrome Development - The Object Interface (OI) tool kit (and Studio?) does not support a two-dimensional (2D) or monochrome MOTIF. We need to run a prototype screen in the monochrome mode to determine impacts on recognizability of the cursor and selectable items.

OI Tool Kit vs. Studio Look-N-Feel - We need to ensure the "screens" the technician sees look and behave the same.

Referencing General Content, Style, Format, and User-Interface (GCSFUI). The demo plan states that General Dynamics Electronics Division (GDE) will be implementing a tailored version of GCSFUI. How are we handling this?

Where will the following be documented?

- Integrated Maintenance Information System-Diagnostic Module user interface,

- Menu Bars,

- Help System,

- Error Messages,

- Any specialized training Software/user interfaces, and

- Description of text editor functions (cut, copy and paste, etc.).

SECTION 2

2.2

Should the cursor disappear while the system draws new screens? Tool kit support? **GDE 1/17**

We need to investigate the software overhead associated w/ time to draw indicator. **GDE TBD**

2.4.1

Functions for progress indicator (Cancel or Stop transaction, Pause, etc).

2.4.2.1

Arrow key signal frequency will be determined through prototyping. **GDE - TBD**

2.5

Verify the system response times? Applied Sciences Associates, Inc. **(ASA) - Date??**

SECTION 3

3.

ISSUE - Do we need a message in cue icon (GDE)? With the addition of new icons needed to support IMIS, we will run out of room.

3.6

ISSUE - soft -key label text size, max length, etc.

ISSUE - F Labels on soft keys? Is there room?

3.7

Technical Order (TO) presentation system windowing capabilities. TO presentation will run on both the Portable Maintenance Aid (PMA) and Maintenance Information Workstation (MIW). In the MIW, TO presentation will be one of several applications which may be open at the

same time. It must have the same windowing characteristics as other IMIS applications. General Dynamics Fort Worth Division (GDFW) - 1/17

Window manager compatibility (MOTIF window navigation support). G. Brown proposed a limited windowing capability for IMIS applications. How limited? Describe.

Need a function to switch between applications (MOTIF). MIW only?

SECTION 4

4.1.2.2

ISSUE - We need to investigate intuitive and complete ways to move the cursor around complex selectable screens. ASA - ??

4.2.1

ISSUE - Should the input cursor blink (for fill-ins)? Regular cursor?

4.2.3

ISSUE -MIW keyboard function to switch between windows (applications), stack, resize, and move windows. Should we use MOTIF assigned or our own function keys? GDE - 1/17

4.2.4

ISSUE - Check on how tool kit highlights a region. GDE - 1/17

4.2.2.2.1

ISSUE - With our current scheme, selectable groups with more than nine items will not be numbered. If these interactions are common, we may have a problem in that the technician will have to press the arrow keys many times to get to a selection. Additionally, the Integrated Maintenance Information Syatem Diagnostic Module (IMIS-DM) block diagrams are numbered and have many more than nine blocks per screen. Are we sure we want number selection to be hot? TBD

4.3.1.1

ISSUE - Does the tool kit provide a visual indication of the active tab group? If not, we may have to customize one. **GDE - 1/17.**

4.3.1.2

ISSUE - We should have a default tab group for each application's information type. The tab group may be consistently placed in a generic location (upper-left-most tab group) or based on user needs (e.g., automatically goes to the scroll bars of scrollable text or graphics panes). We need to describe a default in this section.

4.4.1

ISSUE - Investigate how the tool kit will consistently designate selectable items. Has this changed from our original plan? We want to make sure the cursor location and selectable indicators (e.g., Supp Info) are distinguishable in a monochrome (2D) mode. **GDE - 1/17.**

4.4.2

ISSUE - Supp Info - stay in Supp Info mode? Return takes user to previous thread (Supp Info on or off?) How do we handle Supp Info in parts or other graphic screens where the main interaction is through selecting objects on the screen? Do the menus have both primary and linked information (e.g., detailed part info, higher-level view, lower level view, and Supp Info as options with Supp Info having a submenu of links)? Describe.

SECTION 5

5.1

CHANGE - Add description of the new hierarchy (for list boxes).

5.2.2

Aren't there different menu bars for each application in IMIS? **TBD**

Can the tool kit support not displaying data pane scroll bars when not necessary? This issue was closed under the premise that the tool kit cannot support hiding the scroll bars and using this extra space to display data. This needs to be investigated by calling Gary Aitken at Solbourne (303-678-4336).

ISSUE - How do you scroll a pull-down menu while in drag mode? Describe interaction.

SECTION 6

6.1.3.x

ISSUE - Do we need a Reset function for dialogs or forms (instead of canceling and restarting)? **TBD**

6.2.2.1.1

ISSUE - We may want to consider using autoselect for radio buttons. Tool kit support? **GDE - 1/17**

6.2.3

CHANGE - We need a description of the new hierarchical list box.

ISSUE - Alpha search box on list boxes.

ISSUE - Single vs. multiple selection in list boxes. Is there a need? If so, describe user interface (UI).

ISSUE - We need to use text as list box items (instead of radio buttons or check boxes). The radio type buttons require three steps: place cursor on the item, select it, then press a push button to preform an action on the item. Text items require two steps: place cursor on item then preform the action on it. Call Gary at Solbourne if you have any questions.

6.2.4

ISSUE - How will user switch between insert/overstrike (cannot access menu bar)?

ISSUE - Indentation (parenting) and grouping of related fill-ins on forms?

ISSUE - Cut, copy, and paste? At least on MIW?

6.3.1

How does selection remain "selected" once tab group changes from a list (without cursor interference)? **GDE 1/17**

6.2.4.2.2.

ISSUE - Investigate tool kit support of insert/overstrike? **GDFW-1/17**

6.5.4.2

ISSUE - Cursor display on pop-up keyboard inverted?

ISSUE - Special character set (?,/,#,-, etc.) required to support all IMIS fill-ins? These characters will be required on the PMA pop-up keyboard. Determine from software and data people.

ISSUE - Arrow keys on keyboard vs. having to tab to move input cursor? We need to look at General Dynamics Fort Worth Division (GDFW) March version of the keyboard. Apparently, they didn't have time to develop a HCIS compliant keyboard. Time permitting, we will try to optimize the keyboard.

6.5.4.3

Can tool kit support fill-in option menu? **GDE - 1/17**

SECTION 7

7.1.1

Should we have a general rule for margins (e.g., 1/3, N,1/3, N)?

7.2.1.1

ISSUE - Min and Max for font sizes (capable of supporting a three-foot through six-foot viewing distance)? What is the maximum font size on PMA?

Most of these are "optimized" dimensions. We should get as close as we can. Major deviations may be considered for customization. Eight minutes of arc for MIW? This is wrong! **ASA verify - TBD.**

7.4

ISSUE - Data entry of table information needs to be investigated. Mark's proposed solution may have some problems and needs to be discussed.

7.6

       User prompts should be embedded in the text pane of procedural information (displayed without dialog box push buttons and borders). According to GDFW, the tool kit does not support this; according to Solbourne, it does. We need to investigate this by calling Gary at Solbourne.

7.7.

ISSUE - If we are using autoscroll, we need to add a description of autoscroll. **GDFW - 1/17**

ISSUE - Full screen and reduce/enlarge (zoom)? The zoom function is a demo requirement isn't it? If so, how will GDE handle this and how will it work?

7.7.1

ISSUE - How does the tool kit scroll a data pane with the arrow keys?

APPENDIX C
TECHNICAL ORDER PRESENTATION IMPLEMENTATION ISSUES

4 Dec 91

FROM: Jeffrey L. Wampler (AL/HRGO)

SUBJECT: Status of the Human Computer Interface Specification (HCIS)

TO: Harry English (ASD/YPLT)

    Richard Weimer (AL/HRGO)

    Vinnie Botticelli (GDFW)

    Laurie McCollum (GDE)

1. Due to the consolidation of the F-16 Type C and Integrated Maintenance Information System (IMIS) efforts, General Dynamics Fort Worth Division (GDFW) is developing the authoring and Technical Order (TO) presentation system for the IMIS F-16 demo. The TO presentation section of the HCIS (Section 8) is a working document to describe the user interface and presentation of electronic technical manuals and associated data.

2. The F-16 SPO (GDFW) and AL/HRG (General Dynamics Electronics Division (GDE)), have conducted several HCIS meetings to describe how the presentation system should look and behave. Chapter 8 describes how an ideal TO Presentation System should work. This chapter represents the baseline description of the TO presentation system. As a design goal, the T O Presentation System should be built to reflect the description in Chapter 8.

3. Unfortunately, real world constraints prohibit us from achieving all design goals. In this project, the data base Content Data Modle (CDM), the user-interface tool kit (Solbourne UI Builder) , and software overhead may keep us from developing the ideal system. Since this is a prototype effort, we should document implementation issues so that these "lessons" can be passed on to future efforts.

4. During a Nov 91 meeting, Chapter 8 was reviewed by GDFW and GDE presentation system teams. The HCIS team identified several instances where the proposed design could not be implemented. These implementation issues are attached to this memo and are

divided into three categories: CDM, TK (Tool kit), OH (overhead). Additionally, any unresolved issues have been included in the appropriate section under ISSUES.
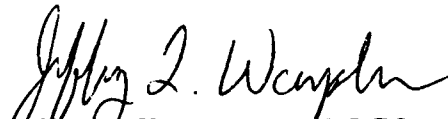
5. Chapter 8 was updated based on the results of the Nov 91 meeting. The text which was added is underlined. Sections which were omitted have been kept on a separate file. GDFW and GDE should review Chapter 8 and comment. Hopefully, with one more review, we can establish an agreed on baseline document. Additionally, GDFW should prepare to discuss each of the ISSUES at the next user interface meeting (date TBD).

6. Chapter 8 should be reviewed by the person responsible for developing the authoring style guide. This person can identify those presentation requests that are either: style issues or beyond the capabilities of the CDM. These "issues" when combined with the presentation system issues, will be invaluable to this and future Type "C" data developments.

7. As GDFW builds the TO Presentation System, they should briefly document any problems implementing the baseline presentation system and provide a recommended solution. The CDM issues should be passed on to the data developers for potential authoring style/CDM changes. The tool kit issues should be considered to extend the tool kit to support the baseline (in some cases it may worth writing extra code to handle UI presentation deficiencies). The SW overhead issues should be evaluated to determine the cost/benefit of implementation.

8. Chapters 1-7 of the HCIS have been reviewed by both GDFW and GDE and are currently going through the same rigor as Section 8.

9. If you have any questions about this memo or suggestions for making this effort work better, please contact me at (513) 255-2606.

Jeffrey L. Wampler, AL/HRGO

2 Atch

1. TO Presents Issues

2. Updated HCIS Section 8

TO PRESENTATION IMPLEMENTATION ISSUES

This document lists the implementation issues encountered by the technical order (TO) presentation team while attempting to develop the TO presentation system as depicted in the Human Computer Interface Specification (HCIS) Section 8. These implementation issues are organized by section and are divided into three categories: content data model (CDM), tool kit (TK), and software overhead (OH). Additionally, any unresolved issues have been included in the appropriate section under ISSUES.

Once the baseline user interface (UI) description of TO presentation is agreed upon, this document will be maintained to keep a library of the design/development issues encountered as the prototype TO presentation system is developed. Currently, most issues in this list are open. As each issue is closed, the solution to the issue will be documented and will be transferred to a permanent issue list, which will be a record of the design decisions/tradeoffs of TO presentation development.

Currently, three major areas of the TO presentation still need work: screen layout, required conditions (and follow-on maintenance), and user prompts. Issues related to the presentation of each of these areas are listed in the appropriate sections.

8.1.2.1 Screen Layout Rules

CDM - We may need a location element under graphic to center potentially large graphics over the component of interest. Otherwise, scrollable graphics will be centered. Is this what the CDM element FOCUS was used for?

CDM - Is there a way to determine the order of presentation of multiple graphics linked to a step (e.g., top to bottom or left to right)?

ISSUES

A. There are not just six static screen templates. Screen layout is dynamic; that is, the text and graphic panes can be any size within the defined constraints. For example, a screen with one text pane and one graphic pane (split side-buy-side, or text-over-graphic) could range from approximately 10 per cent text and 90 per cent graphics to 90 per cent text and 10 per cent graphics. This approach will allow the presentation system to display the required information while minimizing scrolling.

B. We had a discussion at the 6 Nov meeting about the user adjustable font size and it's impact on the minimum text pane width (30 < width < 60). This constraint is to assure that, when sizing the text pane to accommodate the graphic, unreadable (too narrow) text panes are not displayed. Since the user may select a font size which exceeds this constraint (e.g., 36 point font), we may want to select a minimum text pane width independent of font. For example, the minimum width of a text pane may be equivalent to the width of 30 characters at the minimum font size. What is the maximum font size allowable?

C. Are there minimum sizes for scrollable text and graphics panes?

D. Scroll bars should not be displayed if the data pane is not scrollable (they take up more space).

E. We need a description of the scrollable text pane. If we use autoscroll and the text node is too large to fit in the text pane, the scroll slider bar should move upward to indicate there is more information than can be contained on the current screen for the current step. What happens if the user presses NEXT ? If the text doesn't fit in the current text pane (but the graphic does fit), should we use NEXT and BACK to navigate between text sections (within the same node)?

F. If the scrollable text pane is going to contain the complete maintenance session, how do we handle theory and other referenced information? Should the scrollable text pane only contain procedural information (or perhaps only the current task)?

8.3.1 Titles for Procedural information

ISSUES -

A. Closed

8.3.2.1 Personnel, Equipment, and Consumables

T.K. - cannot support the proposed layout for supplies. Tables cannot be presented in the text pane.

CDM - Personnel designation letters are not supported by the CDM.

CDM - How are "Other Recommendations" handled?

ISSUES -

A. Input condition titles are created and displayed by the presentation system. The content of each input condition type (i.e., name, part no., cage number, etc.) is also displayed by the presentation system. The proposed layout of these attributes and titles are dictated by the presentation system and are not author-dependent.

B. GDFW proposed that the new figure for input conditions be replaced with an old figure from the July 91 HCIS. The old figure is generic and provides very little information in describing the screen layout for input conditions. We need to determine which contents from equipment and supplies will be displayed. The old figure provided just a name for these items. Obviously, a part number (or some other identifier) is required to identify and order the equipment/supplies. The new figure uses data from today's technical manuals as a baseline.

Since data layout is not author dependent, this information was not removed from the HCIS (as suggested by GDFW in the Nov 91 meeting). If the number of items is three or more, a table layout would be the best way to display this information. Again, the presentation system determines how these are displayed (not the author).

C. Will NEXT display one subsection (or node) of input conditions (i.e., personnel, equipment, etc.) or will as many input conditions be displayed as possible per each NEXT press?

D. How do we handle an Input conditions node that is too long to fit on the screen? Possibly SCROLL with NEXT/BACK acting as a page turners?

E. Should the technician be able to Exit (Return) a procedure from the input conditions screen(s)? There would be no impact on aircraft state.

F. Should Safety Conditions be displayed as alerts preceding the first step in a task or as another input condition with the SAFETY CONDITIONS header?

G. Will "Other Recommendations" need to be displayed? These are usually references to other TOs and may not be required in Interactive Electronic Technical Manuals (IETMs). If so, are they displayed as part of input conditions?

8.3.2.2 Required Conditions

CDM - The text content of the CDM element RECON should be mandatory. This information is required for paper anyway isn't it?

T.K. - cannot support check boxes in scrollable text window.

ISSUES -

A. The display and interaction of required conditions (RC) needs to be agreed upon and described. According to Vinnie B. and Dave G., RCs are to be displayed by the screen full so that the technician can review and compare/update the systems state vs. the aircraft state (without having to NEXT through each condition). The RC descriptions in Section 8 have not been changed because General Dynamics Fort Worth (GDFW) was working with a non-current version of the CDM. GDFW needs to revisit the proposed RC displays of and provide a recommended presentation to the HCIS group.

B. The GDFW presentation group proposed that RCs be displayed one at a time. This may be OK but we need to show the technician the RCs that have already been completed? Is the order of RC presentation important? If so, it may be difficult to group into completed and uncompleted. How will we display the status of the task (complete or incomplete)?

C. Function keys are TBD based on RC presentation. The technician must be able to access, check-off or uncheck the RC and go back. However, unauthorized technicians will not be able to check off certain tasks. Therefore, the ability to cursor to and select RCs (like regular check boxes) would not be allowed.

D. During RC presentation, BACK should take you to the previous step or to the current task input condition screen, whichever was previously displayed.

E. Can the message line be dynamic like function keys? Too much overhead?

F. GDFW proposed using Complete (instead of deny) for by-passing an RC. Complete is ambiguous and can be used as a verb (as in "I will complete the task") or an adjective (The task is complete). Applied Sciences Associates, Inc. (ASA) suggested using completed. Actually, check, done, check-off or deny will do.

G. Expert/novice impacts make this interface more complex.

8.3.3 Presentation of Steps

CDM - Will the CDM support assigning a symbol (e.g., A, B) to technicians involved in multiple personnel tasks ?

ISSUES -

A. Why is screen refreshed when new base graphic is required?

B. Function-key assignments - NEXT and BACK need to be added; Exit should be removed. The PMA menu key will be a hard key.

C. If the text pane is scrollable and is also the default tab group, the scroll function will (almost) always be active.

D. If the data requires that a new screen of text be displayed, the step previous to the current step should be displayed (as long as all of the current step will fit in the current text pane without scrolling).

E. GDFW refuses to number steps for IETMs. The lab cannot convince GDFW of the importance of numbering steps. Unless GDFW and Mr. English change their position, the steps for the IMIS IETMs will not be numbered.

8.3.3.1 Referenced Tasks

TK - The TK cannot support the display of check boxes in the text pane. This creates a problem if we were planning to use check boxes to indicate task status. Does the check box work in regular text panes?

ISSUES -

A. Referenced tasks should be visually distinct from other steps in a task (e.g., all capital letters--which is similar to the way task titles are displayed in the title bar).

B. Indication that the task has or has not been completed is required.

C. Only authorized users are allowed to by-pass the referenced task. Therefore, the completed function would not be available to "novice" users.

8.3.3.2 User Prompts

TK - The TK cannot support the display of dialog components in the text pane. Therefore, prompts cannot be embedded (and interacted with) in the text and must be presented in dialog boxes.

OH - Displaying the answer to the prompt as a previous step may require too much overhead. If this is the case, we have a problem. The answer to the prompt is part of the history of the maintenance session that the previous step(s) provide.

ISSUES -

A. The presentation system (not the author) determines what keys are mapped to choices of a prompt/dialog.

B. Included in this section are several presentation rules for different types of prompts. We need to work with the authoring people to determine what type of prompts will occur most often. If most prompts can be structured in a yes/no format and/or are always <6, the presentation rule may be to display single-choice dialogs with the choices assigned to the dialog-box push buttons (and soft-function keys). This interaction will require only one key press: press the appropriate function key. Otherwise, single-choice dialogs may have to be presented as radio buttons. If this is the case, a simple yes/no response may require three key presses (1 - place cursor on choice, 2 - select choice, and 3 - acknowledge dialog box and move to NEXT step).

If radio buttons must be used, an alternative solution may be to make radio buttons autoselect. Autoselect works by automatically turning on the radio button at the current cursor location (without having to press SELECT). This would require a change in the description of radio buttons in Section 6 of the HCIS. Also, will the TK support autoselect radio buttons?

C. How would the presentation system indicate default values on a dialog-box push button if push buttons are used to answer prompts?

D. How are selections (graphic or table) displayed?

8.3.3.3 Novice/Expert Tracks

CDM - How does the CDM support the links between expert/novice?

ISSUE -

A. Who is investigating the presentation of novice/expert tracks? The description of presentation was removed from Section 8.

8.3.4 Follow-On Conditions

CDM - GDFW suggested having a component of FOLLOW-ON which will make certain follow-on conditions are mandatory.

CDM - The text component of FOLLOW_ON should be mandatory.

ISSUE -

Interaction with follow-on conditions should be similar to required conditions except that the technician can leave follow-on conditions incomplete.

8.3.5.3 Supplemental Information

TK - Do we have any problems displaying selectable items in scrollable graphics panes? Any other problems with implementing SUPP INFORMATION?

8.3.5.5 Illustrated Parts Breakdown and Theory

ISSUES -

A. During the last HCIS meeting, it was suggested that a pop-up menu be presented at the current cursor location. The current cursor location is used when the cursor is used to select an object (and attention is on the object). In this case, the user is pressing a function key and his/her attention is independent of cursor location. Also, the cursor may not exist on screens without selectable items. Pop-ups generated from soft-function keys should appear in a consistent location.

B. If information exists for only one thing, a menu would be inappropriate.

8.3.5.4 Search

This function will be implemented by GDE.

8.3.6.1 Display Requirements for Alerts and System Messages

ISSUES -

A. Alerts may be displayed one at a time. Should the presentation system generate and display them separately or all up front?

B. A visual indication of the number of alerts (displayed during the natural progression through a procedure) would be nice.

8.3.6.3 Border and Message

TK - The TK cannot support the crosshatched border of warnings.

ISSUE - We need to try to make cautions and warnings visually distinguishable from notes and system messages. The TK may not support a crosshatched border, but maybe GDFW can customize one.

8.3.6.4 Icon and Title

QH - The alert review box (deleted from Section 8) creates too much overhead. We need to determine if it is worth the overhead to allow the user an easier way to review alerts.

ISSUES -

A. The user _does not_ have to acknowledge each alert when _reviewing_ alerts via icon selection. GDFW stated that the alert review box creates too much overhead. We need to find a way to review alerts without forcing the user to view every one.

B. Icons should not only appear in a prioritized order but also should appear in a consistent location.

C. We need a subsection on ICONS in Section 8. The icons in the earlier section of the HICS are primarily for TO Presentation.

8.3.7 Step (TO) Changes

CDM - The CDM does not have a good facility to mark data updates or changes. These changes can occur with text and graphics of steps as well as paragraphs and graphics of

descriptive information (Diag and Parts information?). What about the other information types? Is using the precondition a good way to handle this?

CDM - Location of pointer (hand) to designate area of changed graphic. How would we handle multiple changes to a single graphic, etc.

ISSUES -

A. How long does a change remain a change?

B. Multiple changes are possible on a graphic.

C. We need to do a requirements analysis for IETM changes! GDFW did a good job of describing how changes might be handled. This information has been temporarily removed from the HCIS until the facilities to support changes are included in the CDM.

8.4 DESCRIPTIVE INFORMATIONRMATION

ISSUES -

A. What will be the instructions and function-key assignments for each of the descriptive information types?

B. If we can get titles for all DESCINFO types from the CDM, the titles for each should be displayed in a consistent way in the title bar across different type of displays. Ideally, we should tell what type of information the screen contains followed by the system or component name. For example, "Theory for: SYSTEM XXX" and "IPB for: SYSTEM XXX." not "SYSTEM XXX Theory" and "SYSTEM XXX IPB."

8.4.1 Theory of Operation

ISSUES -

A. The GDFW description (in their Section 8 comments) does not address many issues related to the theory of operation presentation. What if the user accesses information other than procedural and then accesses theory of operation (e.g., procedure -> parts -> Theory)? Does Return take the user to previous thread (parts) or back to Procedure?

Return in HCIS is intended to return to the previous thread (in this case, the user would have to press Return twice to get back to procedure).

B. Theory should be made easier to browse than procedural information Node-by-node presentation is a constraint put on procedural information due to A/C state implications. GDFW said they will investigate easier browsing operations such as: 1) presenting several paragraphs (nodes) of theory at one time, and 2) providing a table of contents (a list of the heading names) via a pop-up menu.

C. Should SUPP INFORMATION be automatically invoked when in theory of operations?

8.4.2 Diagrams

CDM - Diagram element has no title in its content. What will go in the title bar when diagrams are displayed?

ISSUES -

A. The presentation system will display call-outs for all graphics/graphprims contained in an illustrated parts breakdown (IPB) for which there is part information available.

B. How are multiple-level IPBs linked?

C. Authoring people should look at how we plan to display IPBs.

8.5 PARTS INFORMATION

CDM - GDFW commented that there are no title element for parts information. What is the name attribute of PARTINFO used for?

ISSUES -

A. If we can get titles for all DESCINFO types from the CDM, the titles for each should be displayed in a consistent way in the title bar across different type of displays. Ideally, we should tell what type of information the screen contains followed by the system or component name. For example "Theory for: SYSTEM XXX" and "IPB for: SYSTEM XXX." not "SYSTEM XXX Theory" and "SYSTEM XXX IPB."

B. Does usable on code apply anymore?

C. What information should be displayed for detailed parts information?

8.6 MENU BAR

ISSUES - Message line and function keys for menu bar?

8.6.1 Main Menu Options

ISSUES -

A. The proposed menu-bar functions are good if the functions being built by GDFW are the only ones available. Unfortunately, they are not. Once the functions provided by IMIS are integrated into the menu bar, we may want to reorganize/rename the menu titles and functions.

B. The selected parts list function was proposed by GDFW in their first submittal to the Section 8 HCIS. At the last HCIS meeting, the group questioned the need for such a function. Unless someone can identify a need for the parts list function, it will be removed.

C. GDFW, what is the purpose for referenced tasks?

D. GDFW, how will we access/organize all the procedures (system, subsystem, or view package?) under the Available Tasks function?

E. The SSS Browser has been removed because it is an IMIS function.

F. GDFW, what is miscellaneous data? How is it organized into a menu structure for easy access?

8.6.3 Bookmarks

ISSUE -

A. What are the constraints of accessing bookmarks in procedural information? Statically display the node linked to the bookmark (without being able to navigate through the procedure)?

OTHER ISSUES

Look of TK in monochrome mode (black and white). The TO presentation system is being designed in color. However, the PMA for the F-16 demo is using a monochrome display. We need to determine if the TK works well in a monochrome mode.

We uncovered some philosophical differences in the use of the message line and function keys between GDFW and AL/HRG. GDFW plans to use the message line for status messages (e.g., BACK has been selected, SW5 is set to Y). On the other hand, AL/HRG had envisioned using the line for instructional messages (e.g., select a call-out to get parts information). We need to determine the use for the message line and describe its contents for each screen (or information types).

Function keys can be used for data navigation (NEXT, BACK, and Return), answering prompts (Yes and No), and direct menu bar access (IPB or Locator). The presentation system determines which function keys will be available for each screen (or information type). The programmable function keys also need to be defined for each information type.