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Human Factors Design Guide Update (Report Number DOT/FAA/CT-96/01): A Revision to Chapter 8-Computer Human Interface Guidelines

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16. Abstract

This document contains an updated and expanded version of the Human-Computer Interface chapter of the Human Factors Design Guide. A research team of human factors experts evaluated the existing guidelines for relevance, clarity, and usability. They drafted new guidelines as necessary based on relevant sources, and they reorganized the document to increase usability. This resulted in extensive changes to the original document, including the addition of more than 500 new guidelines and 22 new sources. This report contains a brief introduction along with the modified guidelines. This report was previously released in December 2000 as technical note number DOT/FAA/CT-TN00/30.

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Revised Chapter 8 – Computer-Human Interface Guidelines

Executive Summary

The 1996 version of the Human Factors Design Guide (HFDG) consolidated multiple sources of human factors guidance and overcame limitations associated with using military standards and guidelines. Upon publication, the HFDG quickly became a key reference tool for the application of human factors policy to acquisitions and the development of new systems and equipment.

The authors meant the HFDG to be a living document, that is, as new information became available, they intended to update sections to maintain currency. In this way, the HFDG will remain a useful human factors tool.

Chapter 8 of the HFDG, Human-Computer Interface, is one of the most requested bodies of information and also one that has experienced many new developments in recent years. Researchers at the Federal Aviation Administration (FAA) William J. Hughes Technical Center have provided an updated and expanded set of user-interface guidelines that can meet the needs of FAA missions and systems. Although the original HFDG was primarily focused on FAA ground systems and equipment such as those managed and maintained by Airway Facilities, the researchers expanded the coverage beyond maintenance issues.

The revised chapter is limited in scope to human factors guidance related to computer-human interface software. It is not meant to address operability and interface issues related to hardware characteristics such as screen resolution and input devices. These are addressed in other chapters of the HFDG.

Researchers divided the revision process into several phases including the identification of source material, systematic evaluation of literature, reorganization of topic areas, and expert review. The revision resulted in several changes, as follows.

a. The search for current information pertaining to user interface resulted in the addition of 22 new sources.
b. The review of these source documents resulted in the addition of 512 new guidelines that researchers incorporated into the revised document.
c. The reorganization of the revised chapter involved an extensive regrouping of information as well as the removal of redundant guidelines.

1. Introduction

At the time it was written, the Human Factors Design Guide (HFDG) (Wagner, Birt, Snyder, & Duncanson, 1996) represented an extensive contribution to computer interface guidelines. Since the time of its publication, however, there have been changes in technology, continued growth in computer-based systems, and knowledge gained through human factors research. In order to maintain an effective tool in the development of user interfaces, Chapter 8, *Human-Computer Interfaces*, required modernization. This document summarizes the development of an updated and revised set of computer-human interface guidelines based on Chapter 8 of the HFDG. In the appendix, the original HFDG document is referred to as (HFDG, 1996).

This document describes the effort involved to develop and revise the guidelines and the subsequent review by human factors experts. Along with the introductory material briefly describing the creation process, this document contains the new guidelines as an appendix, complete with a table of contents, sources, and an index.

1.1 Background

The 1996 version of the HFDG represented the culmination of several years of guideline development by researchers from the National Airspace System Human Factors Branch (ACT-530) of the Federal Aviation Administration (FAA) William J. Hughes Technical Center. The authors designed it as a comprehensive reference tool to help FAA and contractor human factors professionals carry out FAA human factors policy. They developed it to consolidate and capitalize on multiple sources of human factors design and evaluation guidance and to overcome the limitations associated with using military design guidelines for the FAA acquisition environment.

The researchers identified major FAA needs in a guidelines document during the 1996 effort. Some of these challenges were to place relevant human factors information in a single document rather than a multiplicity of diverse human factors documents, to use up-to-date sources, to organize the document so that users could easily locate the needed information, and to provide a strong and comprehensive computer-human interface section.

The need for a thorough and current chapter on computer-human interface identified in 1996 still exists today, particularly as human factors information on this topic is frequently utilized in software acquisitions. The HFDG contains 14 chapters covering a broad range of topics including general design requirements, maintenance automation, designing equipment for maintenance human-equipment interfaces, computer-human interfaces, workplace design, user documentation, system security, personnel safety, environment, anthropometry, and biomechanics.

The original HFDG focused principally on the Airway Facilities environment. Thus, a strong emphasis existed in the area of maintenance. Since the document was published in 1996, however, it has provided guidance not only for maintenance acquisitions but for acquisitions in other areas of the FAA as well. It is widely used to aid human factors professionals in

supporting a broad range of acquisitions involving air traffic control, automation, aviation security and communication, navigation, and surveillance technologies. Therefore, an additional challenge for the revision effort was to broaden the focus of the HFDG beyond maintenance issues.

1.2 Purpose

The purpose of this document is to provide an updated and expanded set of user-interface guidelines that meet the needs of FAA missions and systems. Expanding the coverage of the design guide for relevance to all aviation systems and organizing the document so that users can easily locate the needed information are additional goals.

1.3 Scope

This document is limited in scope to human factors guidance related to computer-human interface software. It is not meant to address operability and interface issues related to hardware characteristics such as screen resolution and input devices. Although the revised Chapter 8 contains a section on input devices, it was not updated along with the rest of the chapter.

1.4 Shall and Should

Each guideline specified in this document is identified as a “shall” or “should” statement. A solid black square (▪) adjacent to the guideline identifies the "shall" statements. They originate from or are comparable to statements from authoritative sources such as those associated with FAA orders, standards, and military specifications.

Each “should” statement is identified by an open white square (▫). These represent best practices guidance that is applicable in most cases but may involve trade-offs or be influenced by context-specific factors.

2. Method

Researchers organized the revision process into several phases including the identification of source material, systematic evaluation of literature, reorganization of topic areas, and expert review.

2.1 Source Material Identification

In the first phase of the research effort, a research team from ACT-530 identified and obtained computer-human interface source materials from aviation, computer software, nuclear, military, and general human factors sources. The researchers evaluated the adequacy of the source material for inclusion in the revised design guide chapter and rejected documents that did not

contain sufficiently relevant information (e.g., guidelines applicable to only a specific operating system or environment). They attached the applicable references to each guideline, and provided a list of sources at the end of the chapter.

2.2 Literature Evaluation

Using the 1996 HFDG Chapter 8 as a baseline, the team systematically reviewed and evaluated the information contained in the new source material. Occasionally, the information contained in the relevant sources conflicted with the 1996 HFDG Chapter 8 guidelines. In these cases, the researchers consulted additional source material to resolve conflicts. Guidelines from the original Chapter 8 with ambiguous or outdated information were revised to improve clarity and reflect current information. Redundancies in the guidelines were removed. When information from the new source documents warranted the creation of a new guideline, they wrote new paragraphs, and added the source documents to the source list.

2.3 Reorganization

After adding all of the new material and revising and updating the existing guidelines, researchers reorganized the topics and guidelines within the document to facilitate the location of information. They grouped related topics and created new chapter sections from areas that had been expanded due to new information. The wording and scope of the 1996 HFDG Chapter 8 guidelines and topics were carefully reviewed and revised to broaden the focus beyond the maintenance environment.

2.4 Expert Review

A draft of the new Computer-Human Interface chapter was circulated among a select group of human factors professionals for their review and comment. These reviewers provided useful feedback on the chapter organization and the effectiveness, clarity, and relevance of the guidelines. They also identified some topic areas of importance to FAA programs that were in need of expansion. This review was quite extensive, resulting in 399 comments. The research team addressed all of the comments, revising guidelines and obtaining additional references as necessary. They then met with the reviewers to ensure that all of the comments had been addressed satisfactorily.

3. Document Overview

The revision of the 1996 document resulted in several mentionable changes. The search for current information pertaining to user interface resulted in the addition of 22 new source references from government agencies and private industry. The review of these source documents resulted in the addition of 512 new guidelines that were incorporated into the revised document. The reorganization of the revised document involved a systematic regrouping of information as well as the removal of redundant guidelines.

The revised Computer-Human Interface Chapter 8, contained as an appendix within this document, provides a comprehensive set of usable human factors guidelines. As with any set of guidelines, those that are optimal for one situation may not be suitable for another situation due to the trade offs involved between some of the guidelines and context-specific influences. Consequently, these guidelines should be used in conjunction with the advice of a human factors expert.

These guidelines, as a part of the HFDG, are considered to be a living document. It will be updated as needed to keep current with emerging research, technological advances, and user feedback. This will provide the most current human factors knowledge in a usable tool.
The main focus of Chapter 8 is on screen elements. The final section of the revised Chapter 8, Section 8.21, deals with input devices. This section has not been revised but is included in its original state for completeness. It will be treated separately and is slated for future revision. The information on input devices is only included to insure that the information is available until the time it is revised.

The update of Chapter 8 of the HFDG represents one part of a larger scale effort to keep the guidance in the entire HFDG current. The revised Chapter 8 will be incorporated in the future release of a new HFDG CD.

The revised version of Chapter 8 is presented in Appendix A. The document is preceded by a table of contents and contains 21 sections. The guidelines are followed by a glossary containing key terms, a list of references, and an index of keywords that can be used to find information in the document.

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8.0 Computer-Human Interface Guidelines

8.1 Screen design

Screen design refers to the way information is arranged and presented on a display screen. Different systems and applications can perform many tasks. Some systems rely heavily on databases and do not require immediate user response to information displayed on their screens. Other systems, such as control systems, require that the users make immediate decisions and issue commands based on information displayed to them. The designer needs to understand the primary function of the system being developed to provide an effective screen design.

8.1.1 General principles

- **8.1.1.1 Simplicity.** Information should be presented simply and in a well-organized manner. Ways to achieve simplicity include the following:

  a. The screen should appear to be orderly and clutter-free.

  b. Information should be presented in consistent, predictable locations.

  c. The language used should be plain and simple.

  d. The means for moving around the screen and to related screens should be simple.

  e. Interrelationships should be indicated clearly. [Source: DOE HFDG ATCCS, V2.0, 10.1.2; DOD HCISG V2.0, 4.2.1.2]

- **8.1.1.2 Minimal information density.** The information density (the amount of information per unit area) of a screen should be minimized by presenting only information that is essential to a user at any given time. [Source: DOE HFDG ATCCS, V2.0, 10.1.2; DOD HCISG V2.0, 4.2.1.2]

- **8.1.1.3 Screen density.** For text displays, screen density (the ratio of characters to blank spaces) should not exceed 60 %; that is, not more than 60 % of the available character spaces should be filled. [Source: DOE HFDG ATCCS, V2.0, 10.3.2.4; DOD HCISG V2.0, 4.2.3.2.d]

- **8.1.1.4 Directly usable form.** Information shall be presented to a user in a directly usable form; a user shall not have to decode or interpret data. [Source: DOE HFDG ATCCS, V2.0, 10.1.4; DOD HCISG V2.0, 4.2.1.4]

- **8.1.1.5 Whole data sets.** Whenever possible, users should be able to see the whole data set of interest, such as an entire page, map, or graphic. [Source: MIL-HDBK-761A, 5.3.1.1.b]

- **8.1.1.6 Minimizing the user's short-term memory load.** A window should contain all relevant information and should allow a user to complete the task without having to refer to additional information. [Source: DON UISNCCS, V1.2, 8.5.4]

  Example. The application might provide a calendar if specific day and date information is needed.

- **8.1.1.7 Vocabulary.** The words used in all non-editable text shall be task-oriented and familiar to users. [Source: DON UISNCCS, V1.2, 8.4.4]

- **8.1.1.8 Date and time information.** When task performance requires or implies the need to assess the timeliness of information, the display should include time and date information associated with the data. [Source: MIL-HDBK-761A, 5.3.1.1.f]

8.1.2 Context

- **8.1.2.1 Context.** Context should be provided for displayed data. [Source: MIL-HDBK-761A, 5.3.1.5.1.g]

  Example. When a user is changing parameters for a facility, relevant information concerning that facility should be displayed. [Source: MIL-HDBK-761A, 5.3.1.5.1.g]

- **8.1.2.2 Maintaining context.** An application should provide a means for ensuring that a user maintains an understanding of the context in which a task is being performed. [Source: DOE HFDG ATCCS, V2.0, 2.2.1; MIL-HDBK-761A, 5.1.1.5.a]

  Example. The application might display the results of those previous transactions that affect the current one, or it might display currently available options. [Source: DOE HFDG ATCCS, V2.0, 2.2.1; MIL-HDBK-761A, 5.1.1.5.a]

- **8.1.2.3 Highlighting.** When a user is performing an operation on a selected object in a display, that object shall be highlighted. [Source: DOE HFDG ATCCS, V2.0, 2.2.6; MIL-HDBK-761A, 5.1.1.5.g]

  Discussion. In many applications, at least two different methods of selection highlighting can be provided. The first of these highlighting methods occurs when the pointer comes to rest for a predetermined time on a selected object. This is sometimes referred to as dwell emphasis, and it tells the user which object the computer perceives the user is about to select. This highlighting is normally dim white. The second type of highlighting occurs when an actual selection has been made and is normally a bright white. [Source: DOE HFDG ATCCS, V2.0, 2.2.6; MIL-HDBK-761A, 5.1.1.5.g]

- **8.1.2.4 Display of context information.** Information intended to provide a context for the current user-computer interaction shall be displayed consistently for all transactions within an application and among related applications. [Source: DOE HFDG ATCCS, V2.0, 2.2.5; MIL-HDBK-761A, 5.1.1.5.h, 5.1.1.5.j]

- **8.1.2.5 Distinctive position and format.** Displayed options, context information, command entry areas, prompts, advisory messages, and other displayed items (e.g., titles and time signals) relevant to transaction control shall be distinctive in location and format. [Source: MIL-HDBK-761A, 5.1.1.5.i]

- **8.1.2.6 Operational mode.** When an application provides different operational modes, the current mode shall be continuously indicated to a user. [Source: DOE HFDG ATCCS, V2.0, 2.2.4; MIL-HDBK-761A, 5.1.1.5.d]

- **8.1.2.7 Current context indication.** When the consequences of a control entry will differ depending upon the context established by a prior action, a continuous indication of current context should be displayed. [Source: DOE HFDG ATCCS, V2.0, 2.1.1; MIL-HDBK-761A, 5.1.1.5.f]

- **8.1.2.8 No repetitive entry of data.** A user shall not have to reenter data already entered in the current application session or control session. [Source: DOE HFDG ATCCS, V2.0, 2.2.2]

- **8.1.2.9 Action history.** An application should maintain a summary of the transactions that produced the current context and display it at a user's request with an **UNDO** feature linked to each step in the action history. [Source: DOE HFDG ATCCS, V2.0, 2.2.3; MIL-HDBK-761A, 5.1.1.5.c]

- **8.1.2.10 Control parameters display.** A user shall be able to review all active control parameters upon request. [Source: DOE HFDG ATCCS, V2.0, 2.2.7; MIL-HDBK-761A, 5.1.1.5.e]

  Discussion. Control parameters can include current and default settings and settings applicable to a particular mode of operation. These parameters apply to the application software and to parameters of an external system being remotely monitored and controlled. [Source: DOE HFDG ATCCS, V2.0, 2.2.7; MIL-HDBK-761A, 5.1.1.5.e]

8.1.3 Format

- **8.1.3.1 Title.** Every screen shall have a title or header at the top that is separate and distinguishable from the body of the screen and describes briefly the contents or purpose of the screen. [Source: DOE HFDG ATCCS, V2.0, 10.3.2.2; DOD HCISG V2.0, 4.2.3.2.b]

- **8.1.3.2 Reserved areas.** Any interactive elements used in a screen (e.g., prompts, menu bars, command lines, and message areas) shall appear consistently in the same screen location throughout the system or application. [Source: DOE HFDG ATCCS, V2.0, 10.3.2.3, 10.3.2.6; DOD HCISG V2.0, 4.2.3.2.c, 4.2.3.2.f]

- **8.1.3.3 Minimal visual competition.** Information on a display screen should be organized so that visual competition among distinct items of information is minimized. [Source: DOE HFDG ATCCS, V2.0, 10.3.1.2; DOD HCISG V2.0, 4.2.3.1.b]

- **8.1.3.4 Arrangement of screen elements.** Screens should be arranged so that there is a clear differentiation between instructions and data. [Source: DOE HFDG ATCCS, V2.0, 10.4.5;DOD HCISG V2.0, 4.2.4.5]

- **8.1.3.5 Location of displayed instructions.** When instructions to users are included in a display, instructions on how to do something on the screen should precede (be located above or to the left of) the relevant object; instructions about the disposition of the completed screen should be at the bottom of the screen. [Source: DOE HFDG ATCCS, V2.0, 10.3.2.5; DOD HCISG V2.0, 4.2.3.2.e]

- **8.1.3.6 Matching layout to task.** Application designers should design the screen layout so that users can move quickly and easily among items and can manipulate objects in ways that support task performance. [Source: DON UISNCCS, V1.2, 8.5.2]

  > **Example**. When an application generates information that will be presented a page at a time, provide users with controls for performing paging operations. [Source: DON UISNCCS, V1.2, 8.5.2]

- **8.1.3.7 Minimal user effort.** Screens should be designed to minimize both eye and pointer movement and the number of keystrokes required to complete a task. [Source: DOE HFDG ATCCS, V2.0, 10.0; DOD HCISG V2.0, 4.0]

- **8.1.3.8 Matching layout to users' natural patterns.** Screen layout should conform to users' natural scanning order and probable selection sequences. Usually, the order will be from left to right and top to bottom. [Source: DON UISNCCS, V1.2, 8.5.2]

  > **Example**. In button sets and menus, the most frequent choice should appear in the leftmost or top position. [Source: DON UISNCCS, V1.2, 8.5.2]

- **8.1.3.9 Priority of displayed information.** Information should be prioritized so that the most important or critical information is displayed all the time and less important or critical information can be displayed upon a user's request. [Source: DOE HFDG ATCCS, V2.0, 10.1.1; DOD HCISG V2.0, 4.2.1.1]

- **8.1.3.10 User control.** Users should be able to control the amount, format, and complexity of displayed data as necessary to meet task requirements. [Source: MIL-HDBK-761A, 5.3.1.1.d]

- **8.1.3.11 Grouped information.** Groups of data items should be separated by a blank space, lines, color-coding, or other visually distinctive means. [Source: MIL-HDBK-761A, 5.3.1.5.d]

- **8.1.3.12 Task-critical information.** When a window contains task-critical information, that information should be displayed in a way that users can identify easily, (e.g., separating it from other information by a blank space). [Source: DON UISNCCS, V1.2, 8.5.3]

- **8.1.3.13 Primary viewing area.** Information that is particularly important or that requires immediate user response shall be displayed in the user's primary viewing area. [Source: DOD HCISG V2.0, 4.2.4.3]

- **8.1.3.14 Location by importance.** The most important information and controls associated with a task should be located in the upper left part of its window and the least important at the bottom. [Source: DON UISNCCS, V1.2, 8.5.3]

- **8.1.3.15 Ordering of information.** When displayed information is to be used in some spatial or chronological order, its arrangement on the screen shall preserve that order. [Source: DOD HCISG V2.0, 4.2.4.2, 4.2.4.4]

- **8.1.3.16 Ordering method.** When ordering displayed information by sequence, function, frequency, or importance is not appropriate, some other method such as alphabetical or chronological shall be followed. [Source: DOD HCISG V2.0, 4.2.4.2, 4.2.4.4]

- **8.1.3.17 Integrated information.** When a user needs a variety of data to complete a task, those data should be provided in an integrated display, not partitioned in separate windows. [Source: DOE HFDG ATCCS, V2.0, 10.1.3; DOD HCISG V2.0, 4.2.1.3]

8.1.4 Consistency

- **8.1.4.1 Consistent screen structure.** Screens throughout a system or application shall have a consistent structure that is evident to users. [Source: DOE HFDG ATCCS, V2.0, 10.2.1; DOD HCISG V2.0, 4.2.2.1]

- **8.1.4.2 Consistent screen elements.** Elements of screens such as headers, fields, and labels shall have consistent appearance and relative location throughout a system or application. [Source: DOE HFDG ATCCS, V2.0, 10.2.2; DOD HCISG V2.0, 4.2.2.2]

- **8.1.4.3 Input prompts.** When applicable, an input prompt shall have a consistent location on all displays throughout a system or application. [Source: DOE HFDG ATCCS, V2.0, 10.2.3; DOD HCISG V2.0, 4.2.2.3]

- **8.1.4.4 Instructions and error messages.** Instructions and error messages shall appear in a consistent location on the screen. [Source: National Air Traffic Services, 1999 – 1.12.10.3.1]

- **8.1.4.5 Display formats.** The different elements of display formats shall be distinctive within a display. [Source: MIL-HDBK-761A, 5.3.1.5.b]

- **8.1.4.6 Consistent with user expectations.** Data shall be displayed consistently, using standards and conventions familiar to users. [Source: MIL-HDBK-761A, 5.3.1.2.a]

- **8.1.4.7 Consistency within applications.** Data display shall be consistent in word choice, format, and basic style throughout an application and related applications. [Source: MIL-HDBK-761A, 5.3.1.2.b]

8.1.5 Initial display

- **8.1.5.1 Initial display.** The initial display a user sees shall provide access to the highest level functions, resources, and applications available to the user, including access to the log-on screen, user preference settings, utilities (e.g., a calculator, clock, and calendar), and system-level Help. [Source: DOD HCISG V2.0, 4.1.5.1]

- **8.1.5.2 Starting point.** In any display, it shall be obvious where the user is intended to start. Ordinarily, this will be at the upper left part of the screen. [Source: DOD HCISG V2.0, 4.2.3.3; DOE HFDG ATCCS, V2.0, 10.3.3.7]

  Discussion. This might be accomplished by placing the pointer or cursor, if there is one, at that point or by highlighting the first part of the screen. [Source: DOD HCISG V2.0, 4.2.3.3; DOE HFDG ATCCS, V2.0, 10.3.3.7]

8.2 Text entry and display

8.2.1 General

- **8.2.1.1 Complex formats.** Complex formats and embellishments that do not convey useful information shall be avoided. [Source: DOE HFDG ATCCS, V2.0, 9.1.1]

- **8.2.1.2 Appropriateness of format.** The format shall be appropriate to the user's level of training and experience. [Source: DOE HFDG ATCCS, V2.0, 9.1.3]

- **8.2.1.3 User selection of style.** When appropriate, users should be able to select alternative styles of presentation (e.g., graphical or text). [Source: DOE HFDG ATCCS, V2.0, 9.1.5]

8.2.2 Luminance

- **8.2.2.1 Luminance contrast.** Text-background luminance contrast ratios for a variety of tasks and conditions shall not be less than those given in Exhibit 8.2.2.1. [Source: DOD HCISG V2.0, 4.2.3.5.f, 4.3.1.2.j]

Exhibit 8.2.2.1 Luminance contrast ratios for various conditions.

Condition	Ratio of foreground to background
Bright ambient illumination	> 7:1
Dark ambient illumination	3:1 to 5:1
To attract attention	>7:1
To sharpen edges	>7:1
Continuous reading	3:1 to 5:1
Camouflage images or smooth edges	< 3:1

- **8.2.2.2 Dynamic text.** The luminance of dynamic data should be eight times that of the background. [Source: National Air Traffic Services, 1999 - 1.6.13.3]

8.2.3 Data entry and editing

- **8.2.3.1 Case conversion.** When an application requires that all text be in one case, for example upper case, the application should accept typed uppercase and lowercase letters as equivalent and automatically convert the improper case to the proper one. [Source: DON UISNCCS, V1.2, 8.4.5]

- **8.2.3.2 Wild card search characters.** When an application provides a character string-search capability, it should include the following wild card characters:

  a. @ should represent any single upper- or lower-case alphabetic character. For example, abc@d would retrieve abcad, abcEd, and abczd; it would not retrieve abc7d or abcd.

  b. # should represent any single numeric character. For example, 123#4 would retrieve 12334, 12394, and 12304; it would not retrieve 123554 or 123A4.

  c. ? should represent any single alphanumeric character (e.g., any upper- or lower-case alphabetic character, any number, or any punctuation mark). For example, abc?d would retrieve abcAd, abc5d, and abc,d; it would not retrieve abcxxd.

  d. * should represent zero or more alphanumeric characters. For example, abc*d would retrieve abcd, abcad, and abcjf75/kld. [Source: DON UISNCCS, V1.2, 8.4.7]

- **8.2.3.3 Unfilled spaces.** Users shall not have to move a space at a time over unfilled spaces in variable length fields. [Source: MIL-HDBK-761A, 5.2.4.3.e]

- **8.2.3.4 Leading and trailing zeros.** For fixed length fields, a user shall not have to enter leading or trailing zeros to fill a field. [Source: DOE HFDG ATCCS, V2.0, 3.5.1]

  Example. In a fixed length field that requires four digits, if a three-digit number such as 813 is entered into that field, do not require the user to precede the number with a leading zero (e.g., 0813). Likewise, in a fixed length field involving decimal values, do not require the user to enter a value such as 10 with trailing zeros (e.g., 10.00).

- **8.2.3.5 Justification of entries.** When a user makes an entry that does not fill a variable length field, the entry shall be automatically justified when the cursor leaves the field. Unless otherwise required by processing or display requirements, justification shall be as follows:

  a. Alphanumeric input shall be left justified.

  b. Integer numerical data shall be right justified.

  c. Decimal numerical data shall be decimal-point justified. [Source: MIL-HDBK-761A, 5.2.4.3.c, 5.2.4.3.d]

- **8.2.3.6 User pacing.** The user, not the system, shall set the pace. [Source: Department of Defense, 1996 - 5.15.2.1.1]

- **8.2.3.7 Interrupt capabilities.** Users shall have the ability to use **Backup**, **Cancel**, and **Restart** actions to edit a form at any time prior to the final completion action. [Source: DOE HFDG ATCCS, V2.0, 3.1.2]

- **8.2.3.8 Editing entries.** Users shall be able to move the cursor to any unprotected field and change any entry prior to taking a final completion action. [Source: MIL-HDBK-761A, 5.2.4.3.b]

- **8.2.3.9 Explicit completion action.** A form shall not be removed from display until the user takes an explicit completion action such as pressing the **Enter** key. [Source: DOE HFDG ATCCS, V2.0, 3.1.3; MIL-HDBK-761A, 5.2.4.3.b]

8.2.4 Text entry

8.2.4.1 General

- **8.2.4.1.1 Document operations.** As appropriate, users should be able to **Save, Retrieve, Edit, Delete, Print** (all or specified portions such as a selection, single page, or range of pages), and **Rename** documents. [Source: DON UISNCCS, V1.2, 9.3.1]

- **8.2.4.1.2 Text manipulation.** When appropriate, users should be able to specify the format of a document (e.g., set margins and tab stops) and to select the font type, size, and style for text. [Source: DON UISNCCS, V1.2, 9.3.2]

- **8.2.4.1.3 Undo.** Users shall be able to reverse a previous action or actions with an **Undo** command. [Source: Apple Computer Inc., 1992 – p. 113]

- **8.2.4.1.4 Line breaks and page breaks.** Automatic line breaks and page breaks should be provided. [Source: DON UISNCCS, V1.2, 9.3.2]

- **8.2.4.1.5 Page numbering.** Users should be able to assign page numbers as well as have them supplied automatically. [Source: DON UISNCCS, V1.2, 9.3.2]

- **8.2.4.1.6 Search and replace capabilities.** Users should have both search and search-and-replace capabilities in text windows. [Source: DON UISNCCS, V1.2, 9.3.2]

- **8.2.4.1.7 Insert mode.** Insert should be the default text entry mode. [Source: DON UISNCCS, V1.2, 2.3.3.2]

- **8.2.4.1.8 Backspace key.** The **Backspace** key should delete the character to the left of the text cursor. [Source: DON UISNCCS, V1.2, 2.3.3.2]

- **8.2.4.1.9 Delete key.** The **Delete** key should delete the character to the right of the cursor. [Source: DON UISNCCS, V1.2, 2.3.3.2]

- **8.2.4.1.10 Manipulating text.** Users should be able to highlight blocks of text and perform such operations as moving, copying, and deleting on the blocks. [Source: DON UISNCCS, V1.2, 2.3.3.2]

- **8.2.4.1.11 Text entry.** Text entry shall be possible only when the text cursor is visible in a location that can accept text entry. [Source: DON UISNCCS, V1.2, 2.3.3.1]

- **8.2.4.1.12 Current position in document.** The current position in the document (e.g., the current page or line number) shall be displayed in a consistent location, such as in the window's message area. [Source: DON UISNCCS, V1.2, 9.3.1]

- **8.2.4.1.13 Text input area.** The system shall provide a sufficient screen-working area that permits users to enter and edit text. [Source: MIL-HDBK-761A, 5.2.3.a]

- **8.2.4.1.14 Multiple input devices.** When the system provides more than one input device, for example, both a pointing device and a keyboard, a user should not have to alternate between devices. [Source: MIL-HDBK-761A, 5.2.2.4.a, 5.2.4.4.b, 5.2.2.4.c]

Discussion. One solution is to provide both devices with the ability to perform all operations. [Source: MIL-HDBK-761A, 5.2.2.4.a, 5.2.4.4.b, 5.2.2.4.c]

- **8.2.4.1.15 Frequently used text blocks.** When applicable, a system should provide users a means for storing and retrieving frequently used blocks of text (e.g., distribution lists). [Source: DOE HFDG ATCCS, V2.0, 10.3.1.3; DOD HCISG V2.0, 4.2.3.1.c]

- **8.2.4.1.16 Status of requests.** The user should be informed of the status of requests for printouts (e.g., when a printout has been completed). [Source: CTA, 1996 - 3.2.2.10.2]

8.2.4.2 Text frames

- **8.2.4.2.1 Text frame.** The user should be able to move unselected text frames by clicking inside the frame and dragging inside it and selected frames by dragging the outside border of the frame. [Source: Microsoft Corp., 1992 - 3.9]

  Definition. A **text frame** is a sizable field into which the user can type text. This is a dynamic form of an edit field not to be confused with the text box. Although text frames are generally rectangular, other shapes may also be used. [Source: Microsoft Corp., 1992 - 3.9]

- **8.2.4.2.2 Resizing a text frame.** When a text frame is resized, the text should be rewrapped to fit within the new borders of the frame. [Source: Microsoft Corp., 1992 - 3.9]

- **8.2.4.2.3 Text frame pointer.** When the pointer is over an unselected text frame it should appear as an arrow. When the frame is selected, the pointer should change to an I-beam over the text, to an arrow over the border, and to a resize pointer over a resize handle. [Source: Microsoft Corp., 1992 - 3.9]

- **8.2.4.2.4 Resizing text frames.** When a text frame is selected it should have resize handles. [Source: Microsoft Corp., 1992 - 3.9]

8.2.4.3 Formatting

- **8.2.4.3.1 Text format.** The system should provide a default format for standard text input. [Source: MIL-HDBK-761A, 5.2.3.b]

- **8.2.4.3.2 Custom text format.** When a system provides users with the ability to define their own formats, it should include a means for them to store those formats for future use. [Source: MIL-HDBK-761A, 5.2.3.b]

- **8.2.4.3.3 Page formatting.** The system should provide users with an easy means for specifying page formats, including margins and tabs. [Source: MIL-HDBK-761A, 5.2.3.3.a]

- **8.2.4.3.4 Automatic line breaks.** The system should provide automatic line breaks and automatic word-wrap when text reaches the right margin. [Source: MIL-HDBK-761A, 5.2.3.3.b]

- **8.2.4.3.5 User specified line breaks.** The system should provide for user-specified line breaks. [Source: MIL-HDBK-761A, 5.2.3.3.b]

- **8.2.4.3.6 Default justification of text.** Unless otherwise specified by a user, text should be left justified with consistent spacing between words as it is entered. [Source: MIL-HDBK-761A, 5.2.3.3.e]

- **8.2.4.3.7 User defined text justification.** Left, right, center, and full justification should be provided as user options. [Source: MIL-HDBK-761A, 5.2.3.3.e]

- **8.2.4.3.8 Automatic hyphenation.** The system should provide automatic hyphenation of words at a user's request. [Source: MIL-HDBK-761A, 5.2.3.3.c]

- **8.2.4.3.9 Default hyphenation.** The default mode should be no hyphenation. [Source: MIL-HDBK-761A, 5.2.3.3.c]

- **8.2.4.3.10 Page breaks.** The system should provide automatic page breaks and user-specified page breaks. [Source: MIL-HDBK-761A, 5.2.3.3.d, 5.2.3.3.1.a]

- **8.2.4.3.11 Widow-orphan protection.** Users should be able to specify a minimum number of lines of a paragraph that will appear at the bottom or top of a page (widow-orphan protection). [Source: MIL-HDBK-761A, 5.2.3.3.d, 5.2.3.3.1.a]

- **8.2.4.3.12 Page numbering.** Automatically incremented page numbering should be provided. [Source: MIL-HDBK-761A, 5.2.3.3.c, 5.2.3.3.d]

- **8.2.4.3.13 Default numbering and override.** Page numbering should begin with one by default, but allow users to override the default by specifying a beginning page number. [Source: MIL-HDBK-761A, 5.2.3.3.c, 5.2.3.3.d]

8.2.5 Text display

This section contains criteria and guidelines for displaying text.

8.2.5.1 General

- **8.2.5.1.1 Consistent wording and structure.** The wording and grammatical structure of displayed data and labels shall be consistent throughout an application and related applications. [Source: MIL-HDBK-761A, 5.3.1.3.b, 5.3.1.3.c]

- **8.2.5.1.2 Sentence structure.** In continuous text, sentences should be simple, affirmative, and active as opposed to complex or compound, negative, and passive. [Source: DON UISNCCS, V1.2, 8.4.4]

- **8.2.5.1.3 Sentences begin with main topic.** The main topic sentence should be located near the beginning of the paragraph. [Source: Ameritech Services Inc., 1998 - 4.7.5]

- **8.2.5.1.4 Clarity of wording.** Text displays should employ simplicity and clarity of wording. [Source: Ameritech Services Inc., 1998 - 4.7.5]

- **8.2.5.1.5 Concise wording.** The text should be worded concisely to aid in comprehension. [Source: Ameritech Services Inc., 1998 - 4.7.5]

- **8.2.5.1.6 Punctuation.** Punctuation should only be used when needed within complete sentences to add clarity, or to partition long data items. [Source: National Air Traffic Services, 1999 - 1.6.5.3.2]

- **8.2.5.1.7 Syntax.** Syntax should be consistent throughout an operating system. [Source: National Air Traffic Services, 1999 - 1.6.5.3.2]

  Example. Always use commas, spaces, and so on in the same way and in the same position within command sentences. [Source: National Air Traffic Services, 1999 - 1.6.5.3.2]

- **8.2.5.1.8 Breaking up words.** When displaying text, words should remain intact with minimal breaking or hyphenation between the lines of text. [Source: National Air Traffic Services, 1999 - 1.6.5.3.3]

  Discussion. Placing a word entirely on a single line increases readability. [Source: National Air Traffic Services, 1999 - 1.6.5.3.3]

- **8.2.5.1.9 Breaking up large blocks of text.** Large blocks of text should be broken into smaller, meaningful portions to minimize the amount of information requiring the user's attention at any given time. [Source: DOE HFDG ATCCS, V2.0, 10.3.3.1, 10.3.3.3; DOD HCISG V2.0, 4.2.3.3.a, 4.2.3.3.c]

  Discussion. Continuous text can be broken up by the use of blank lines or by using lines drawn between or around portions of text. The readability of large amounts of text may be improved by presenting the text in two columns. The use of different intensity levels is another possibility but may be undesirable depending upon the levels available and the ambient lighting conditions.

- **8.2.5.1.10 Minimum number of displayed lines.** When a user must read continuous text on-line, a minimum of four lines of text should be displayed at one time. [Source: Nuclear Regulatory Commission, 1996 - 1.2.1-11]

- **8.2.5.1.11 Contrast.** Text should be displayed as black characters on a white or light background. [Source: DON UISNCCS, V1.2, 8.4.1]

- **8.2.5.1.12 Stationary text.** Text information shall be stationary on the screen, not scrolled continuously except with user action. [Source: DOD HCISG V2.0, 4.2.3.6.a]

- **8.2.5.1.13 Distinctive appearance.** Text entered by a user shall be clearly distinguishable from system-supplied text that also appears on the screen. [Source: MIL-HDBK-761A, 5.2.3.d]

- **8.2.5.1.14 Display text.** The user shall be allowed to display text as it will be printed including underlining, boldface, subscript, superscript, special characters, special symbols, and different styles and sizes of type. [Source: CTA, 1996 - 3.2.2.10.1]

8.2.5.2 Text in windows

- **8.2.5.2.1 Arabic vs. Roman numerals.** When information elements in a window will be numbered, Arabic numerals should be used, not Roman numerals. [Source: DON UISNCCS, V1.2, 8.4.2]

- **8.2.5.2.2 Consistent structure for non-editable text.** Each type of non-editable text (e.g., titles, labels, and instructions) displayed in windows should have a consistent grammatical structure. For example, all instructions might be complete, imperative sentences. [Source: DON UISNCCS, V1.2, 8.4.4]

- **8.2.5.2.3 Punctuation.** Normal punctuation rules should be followed. Contractions and hyphenation should be avoided. [Source: DON UISNCCS, V1.2, 8.4.4]

- **8.2.5.2.4 Sequences.** Sequences of events or steps shall be presented in the proper order. [Source: DON UISNCCS, V1.2, 8.4.4]

- **8.2.5.2.5 Referents.** The referents for pronouns such as "it" and "they" shall be easily identifiable. [Source: DON UISNCCS, V1.2, 8.4.4]

8.2.5.3 Text alignment

- **8.2.5.3.1 Orderly format.** Designers should attend to the alignment and labeling to improve user-interface consistency.

  a. Align decimal points when listing numbers with decimal values.

  b. When decimal values are not used, numbers are flushed right.

  c. Alphabetic listings are flushed left.

  d. Labels describe the contents of the lists and are flushed left or centered. [Source: CTA, 1996 - 3.5.3]

- **8.2.5.3.2 Alignment grid.** The system should provide the capability of aligning objects on an invisible rule or grid structure at a user's request. [Source: MIL-HDBK-761A, 5.2.6.c, 5.2.6.2.a]

- **8.2.5.3.3 Grid intervals.** Users should be able to specify grid intervals. [Source: MIL-HDBK-761A, 5.2.6.c, 5.2.6.2.a]

8.2.5.4 Abbreviations

- **8.2.5.4.1 Abbreviations.** When a system or application uses abbreviations in its user-computer interface, the abbreviations shall be unique, distinct, and unambiguous so as not confuse users. [Source: MIL-HDBK-761A, 5.1.1.6.e; MIL-STD-12D, 3.1]

  Definition. An **abbreviation** is any shortened form or abridgment of a word, expression, or phrase used to conserve space or time. Thus, the term abbreviation includes initializations, contractions, and acronyms

- **8.2.5.4.2 System operation time.** The use of abbreviations shall not add to system operation time. [Source: MIL-HDBK-761A, 5.1.1.6.e; MIL-STD-12D, 3.1]

- **8.2.5.4.3 Use of abbreviations.** When the abbreviation of a word is not clear or may be misinterpreted, the entire word shall be used. [Source: Department of Defense, 1984]

- **8.2.5.4.4 Minimal use.** The use of abbreviations shall be minimized. [Source: DOE HFDG ATCCS, V2.0, 10.3.1.3; DOD HCISG V2.0, 4.2.3.1.c]

- **8.2.5.4.5 Acronyms.** Acronyms should be used only if they will be seen more than once, are significantly shorter than the term they represent, and the users will commonly understand them. [Source: DON UISNCCS, V1.2, 8.4.2, 8.4.3]

- **8.2.5.4.6 Acronym format.** Acronyms should be displayed in all upper-case letters. [Source: DON UISNCCS, V1.2, 8.4.2, 8.4.3]

- **8.2.5.4.7 Consistent abbreviation use.** When abbreviations are used, they shall be used consistently throughout an application or set of related applications. [Source: DOE HFDG ATCCS, V2.0, 10.3.1.3; DOD HCISG V2.0, 4.2.3.1.c]

- **8.2.5.4.8 Selecting abbreviations.** When a word needs to be abbreviated, the abbreviation should be selected from FAA Order 7340.1, taken from commonly used abbreviations, or constructed according to the rules of the U.S. Government Printing Office *Style Manual*. [Source: MIL-HDBK-761A, 5.1.1.6.a]

- **8.2.5.4.9 Definitions of abbreviations.** When a system or application uses abbreviations in its user-computer interactions, it shall provide an easy on-line, context-sensitive means for a user to learn the definition of an abbreviation, such as an on-line dictionary or Help screen. [Source: DOE HFDG ATCCS, V2.0, 2.1.5; MIL-HDBK-761A, 5.1.1.6.d; DON UISNCCS, V1.2, 8.4.3]

- **8.2.5.4.10 Punctuation.** All punctuation marks should be omitted from acronyms and abbreviations unless confusion or misinterpretation would occur as a result of their omission. [Source: Department of Defense, 1984]

- **8.2.5.4.11 Alphabetic similarity.** Abbreviations should retain an alphabetic similarity to the longer word or phrase. [Source: FAA, 2000]

- **8.2.5.4.12 Words not to abbreviate.** Words of five letters or less should not be abbreviated unless common usage has rendered the word and its abbreviation completely synonymous in recognition and intelligibility. [Source: FAA, 2000; Department of Defense, 1984]

- **8.2.5.4.13 Prepositions, conjunctions and articles.** Prepositions, conjunctions, and articles should be omitted when forming acronyms. [Source: FAA, 2000]

- **8.2.5.4.14 Pronounceable acronyms**. A pronounceable word should be attained, if possible, when creating an acronym. [Source: FAA, 2000]

8.2.5.5 Labeling

- **8.2.5.5.1 Distinct, unique, descriptive labels.** Each data group, message, or display should contain a distinct, unique, descriptive, and consistently worded title or label. [Source: MIL-HDBK-761A, 5.3.1.4.a, 5.3.1.4.d, 5.3.1.5.1.a]

- **8.2.5.5.2 Alphanumeric labels.** The labels of screens should be alphanumeric. When they are not complete words, labels should be abbreviations that are short enough (three to seven characters) or meaningful enough to be learned and remembered easily. [Source: MIL-HDBK-761A, 5.3.1.4.b]

- ▫ **8.2.5.5.3 Consistent location.** Label locations and formats should be consistent. [Source: MIL-HDBK-761A, 5.3.1.4.e]

- ▫ **8.2.5.5.4 Spacing.** At least one blank line should separate a title from the body of a display. [Source: MIL-HDBK-761A, 5.3.1.5.1.b]

- ▪ **8.2.5.5.5 Display identification.** When a system allows users to select and manipulate displays, each display shall have an identifying label and other identifying information to support display control and data access. [Source: MIL-HDBK-761A, 5.3.2.3.a]

8.2.5.6 Characters and spacing

- ▫ **8.2.5.6.1 Spacing between characters.** Spacing between characters should be at least 10% of character height. [Source: DOD HCISG V2.0, 4.2.3.5.c]

- ▪ **8.2.5.6.2 Spacing between words.** Spacing between words shall be at least one character width for equally spaced characters or the width of capital N for proportionally spaced characters. [Source: MIL-STD-1472F, 5.5.5.12]

- ▪ **8.2.5.6.3 Spacing between lines.** Spacing between lines shall be at least two stroke widths or 15% of character height, whichever is greater. This space is in addition to any space required for accent marks on upper case characters and descenders on lower case letters. [Source: DOD HCISG V2.0, 4.2.3.5.c]

  Discussion. The interline spacing recommended for text displayed on terminals is greater than that recommended for printed material. *Descenders* are the part of lowercase letters that extend below the base line on which the letter is positioned.

- ▪ **8.2.5.6.4 Spacing between paragraphs.** Paragraphs shall be separated by a blank line. [Source: DOD HCISG V2.0, 4.2.3.5.c; DOE HFDG ATCCS, V2.0, 10.3.3.5]

- ▫ **8.2.5.6.5 Preferred character height.** The character height for maximum legibility and readability should be 20 to 22 minutes of arc. [Source: ANSI, 1988]

  Discussion. To account for both the size of symbols and characters and the viewing distance, visual angle should be used as the unit of measurement. Visual angles are specified in terms of minutes of arc or degrees (1 degree = 60 minutes of arc).

- ▪ **8.2.5.6.6 Minimum character height.** The minimum character height for tasks in which legibility is important shall be 16 minutes of arc. [Source: ANSI, 1988]

- **8.2.5.6.7 Time insensitive character recognition.** Character height for reading tasks in which identification of individual characters is not time-critical should be at least 10 minutes of arc. [Source: ANSI, 1988]

- **8.2.5.6.8 Maximum character height.** The maximum character height for non-contextual groups of characters should not exceed 45 minutes of arc. [Source: ANSI, 1988]

- **8.2.5.6.9 Maximum character height for reading.** The maximum character height for readability shall be 24 minutes of arc. [Source: ANSI, 1988]

- **8.2.5.6.10 Character width.** The ratio of character height to width shall be

  a. 1:0.7 to 1:0.9 for equally-spaced characters and lines of 80 or fewer characters,

  b. at least 1:0.5 if it is necessary to have more than 80 characters per line, or

  c. as much as 1:1 for characters such as M and W for proportionally spaced characters. [Source: DOD HCISG V2.0, 4.2.3.5.d]

- **8.2.5.6.11 Character luminance.** In a monochromatic display, the variation of a peak luminance of character elements (dots or strokes) should not exceed a ratio of 1.5:1 within a character. [Source: National Air Traffic Services, 1999 - 1.6.11.2]

- **8.2.5.6.12 Character contrast.** For optimum legibility, character contrast should be between 6:1 and 10:1. [Source: National Air Traffic Services, 1999 - 1.6.13.1]

  Discussion. Legibility may diminish with contrasts below 3:1, whereas contrasts above 15:1 may cause visual discomfort. [Source: National Air Traffic Services, 1999 - 1.6.13.1]

- **8.2.5.6.13 Adjustable contrast.** Contrast should be adjustable to compensate for ambient lighting conditions. [Source: National Air Traffic Services, 1999 - 1.6.13.1]

- **8.2.5.6.14 Stroke width.** Stroke width should be 10 to 12.5 % of character height. [Source: DOD HCISG V2.0, 4.2.3.5.d]

- **8.2.5.6.15 Minimum dot matrix.** When characters are formed using a dot matrix, the matrix should be at least 7 dots wide and 9 dots high. [Source: DOD HCISG V2.0, 4.2.3.5.e; DON UISNCCS, V1.2, 8.4.1]

  Discussion. Alphanumeric characters are generally created using either the dot matrix method (using matrices of round or square dots) or the grid method (using strokes). The dot matrix method is the more legible of the two. [Source: National Air Traffic Services, 1999 - 1.6.1]

- **8.2.5.6.16 Dot matrix shape.** The dots used to form dot matrix characters should be round or square. [Source: National Air Traffic Services, 1999 - 1.6.1]

8.2.5.7 Text font

- **8.2.5.7.1 User-selectable font size.** When an application cannot satisfy the range of viewing requirements with a single text font, the application should provide text font size as a user-selectable option. [Source: DON UISNCCS, V1.2, 8.4.1]

  Discussion. Consider that differences exist between typefaces. For example, 10 pt letters in one typeface may have the same character size as 12 pt letters in another. A *font* refers to a particular typeface and size (e.g., 12 point Times New Roman).

- **8.2.5.7.2 Fonts to differentiate information.** Multiple fonts should be used to indicate categories of information or for moderate emphasis. [Source: National Air Traffic Services, 1999 - 1.11.11.2]

- **8.2.5.7.3 Number of different fonts.** There shall be a limit of two different fonts displayed on any one screen. [Source: National Air Traffic Services, 1999 - 1.11.11.3]

- **8.2.5.7.4 Text size and style.** Variations in the size and style within a font should be used to categorize the information into different levels. [Source National Air Traffic Services, 1999 - 1.11.11.4]

- **8.2.5.7.5 Serif typeface.** For maximum readability, serif fonts should be used for continuous body text as long as the typeface is large or the resolution is high enough not to distort the serifs. [Source: Neilson 2000, p. 126]

  Discussion. A *serif* is the small cross stroke at the end of the main stroke of the letter.

- **8.2.5.7.6 Sans serif typeface.** Sans serif typeface should be used for small text and low resolution displays. [Source: Neilson 2000, p. 126]

8.2.5.8 Capitalization

- **8.2.5.8.1 Capitalization.** Text should be presented in a combination of uppercase and lowercase letters, following standard capitalization rules (e.g., the U. S. Government Printing Office *Style Manual*). [Source: DON UISNCCS, V1.2, 8.4.2]

- **8.2.5.8.2 Capitalization of phrases for emphasis.** In general, capitalization shall not be used to emphasize phrases or sentences. [Source: MIL-STD-490A, 3.2.6]

  Discussion. Continuous text is easiest to read and comprehend when it is presented in mixed case letters. Single words are recognized better when printed in all upper case letters. Thus, if used sparingly and wisely, capitalization can be used to indicate to readers that a word has special significance.

- **8.2.5.8.3 Use of capitals.** Capitalization should *only* be used for: headlines, key phrases or acronyms, short items to draw the user's attention to important text (e.g., field labels or a window title), the first letter in a sentence, or a single character in each word in a title or label. [Source: National Air Traffic Services, 1999 - 1.6.5.2.1]

- **8.2.5.8.4 Mixed case.** Mixed case should be used for continuous text, messages, menu descriptions, button descriptions, or screen identification. [Source: National Air Traffic Services, 1999 - 1.6.5.2.1]

8.2.6 Text coding

8.2.6.1 Alphanumeric coding

- **8.2.6.1.1 Supplemental use only.** Alphanumeric coding should not be used as the sole means to call attention to important or critical information. [Source: MIL-HDBK-761A, 5.3.1.6.1.a]

- **8.2.6.1.2 Case of letters.** Alphanumeric codes should use either upper case letters or lower case letters consistently and not use mixed case letters. [Source: MIL-HDBK-761A, 5.3.1.6.1.b]

  Discussion. Mixed case words are often seen in tables and sometimes in labels. The added capital letters can interfere with quick reading and differ from the expected convention of only capitalizing proper names and titles, thus contributing to difficulty in comprehension. Attend to the size of letters for legibility of the smallest letters in all cases.

- **8.2.6.1.3 Mixed letter and number codes.** When codes contain both letters and numbers, the letters should be grouped and the numbers should be grouped rather than interspersing letters with numbers. [Source: MIL-HDBK-761A, 5.3.1.6.1.c]

  Example. The code HW5 might be used rather than the code H5W. [Source: MIL-HDBK-761A, 5.3.1.6.1.c]

- **8.2.6.1.4 Length of codes.** Arbitrary alphanumeric codes that are to be recalled by users should have no more than five characters and should be the same length. [Source: MIL-HDBK-761A, 5.3.1.6.1.d]

- **8.2.6.1.5 Punctuation in codes.** The use of punctuation in alphanumeric codes should be used only when the code may be confused with a word. [Source: CTA, 1996 - 4.2.5.5]

- **8.2.6.1.6 Short abbreviations or arbitrary codes.** When arbitrary codes must be remembered by the user, characters should be grouped in blocks of three to five characters, separated by a minimum of one blank space or other separating character such as a hyphen or slash. [Source: Nuclear Regulatory Commission, 1996 - 1.3.2-5]

- **8.2.6.1.7 Avoid O and I in arbitrary codes.** The use of the letters O and I in a non-meaningful code should be avoided because they are easily confused with the numbers 0 (zero) and 1 (one), respectively. [Source: Nuclear Regulatory Commission, 1996 - 1.3.2-6]

8.2.6.2 Underlining coding

- **8.2.6.2.1 Use of underlining.** Underlining should only be used for mildly emphasizing information, indicating key words or phrases, or distinguishing fields from text. [Source: National Air Traffic Services, 1999 - 1.11.12.1]

- **8.2.6.2.2 Underlining text.** Underlining should not be used for large amounts of consecutive text. [Source: National Air Traffic Services, 1999 - 1.11.12.1]

  Discussion. Underlining can reduce the legibility of text, making reading difficult. [Source: National Air Traffic Services, 1999 - 1.11.12.1]

8.2.6.3 Bold coding

- **8.2.6.3.1 Suitability/appropriateness of bold coding.** Bold coding should be used for strong emphasis**.** [Source: National Air Traffic Services, 1999 - 1.11.14.1]

- **8.2.6.3.2 Number of levels of bold coding.** No more than three levels of bold coding should be used. [Source: National Air Traffic Services, 1999 - 1.11.14.2]

8.2.6.4 Numeric coding

- **8.2.6.4.1 Digital form.** Data should not be presented in digital form unless the user needs specific numeric values. [Source: National Air Traffic Services, 1999 - 1.11.17.1]

- **8.2.6.4.2 Number of characters.** Numeric codes should be limited to fewer than seven characters. [Source: National Air Traffic Services, 1999 - 1.11.17.2]

8.2.7 Numeric and date/time format

- **8.2.7.1 Number system.** Numeric data should be displayed in the decimal rather than binary, octal, hexadecimal, or other number system. [Source: Nuclear Regulatory Commission, 1996 - 1.3.5-1]

- **8.2.7.2 Leading zeros.** Leading zeros in numeric entries for whole numbers should be suppressed. [Source: Nuclear Regulatory Commission, 1996 - 1.3.5-2]

- **8.2.7.3 Justification.** Integers should be right justified. [Source: National Air Traffic Services, 1999 - 1.11.17.4]

- **8.2.7.4 Decimals**. The system should not require the entry of the decimal point at the end of an integer. [Source: CTA, 1996 - 4.2.3.4].

- **8.2.7.5 Maintaining significant digits.** A displayed value should contain the number of significant digits required for users to perform their tasks. [Source: Nuclear Regulatory Commission, 1996 - 1.3.5-3]

- **8.2.7.6 Display range.** Numeric displays should accommodate the full range of the variable. [Source: Nuclear Regulatory Commission, 1996 - 1.3.5-4]

- **8.2.7.7 Orientation of numbers.** All numbers should be oriented upright. [Source: Nuclear Regulatory Commission, 1996 - 1.3.5-8]

8.2.8 Paging

- **8.2.8.1 Multi-page displays.** When a data set contains too much data for presentation in a single display, the data should be partitioned into separately displayable pages. [Source: MIL-HDBK-761A, 5.3.1.5.2.a]

- **8.2.8.2 Partitioning data among pages.** Related data should appear on the same page in an integrated display rather than being partitioned into separate pages. [Source: MIL-HDBK-761A, 5.3.1.5.2.b]

- **8.2.8.3 Labeling pages.** Each page in a multi-page data set should be labeled to show its relation to the others. For example, the first page of a three-page set might be labeled **Page 1 of 3**. [Source: MIL-HDBK-761A, 5.3.1.5.2.c]

- **8.2.8.4 Consistent orientation.** A consistent orientation for display framing should be used. [Source: Nuclear Regulatory Commission, 1996 - 2.5.5-2]

- **8.2.8.5 Moving through data.** A consistent and easy means should be provided for moving through a data set, for example, scrolling, paging, or panning. [Source: MIL-HDBK-761A, 5.3.2.2.a; MIL-HDBK-761A, 5.3.2.2.b, 5.3.2.2.1]

  Definitions. Scrolling is a method used to move through the contents of a window or list in a dialogue box using the scroll-bar or scroll arrows. **Paging** is the process of scrolling through data one page at a time. **Panning** is an orientation of display framing in which a user conceives of the display frame as moving over a fixed array of data. [Source: MIL-HDBK-761A, 5.3.2.2.a; MIL-HDBK-761A, 5.3.2.2.b, 5.3.2.2.1]

- **8.2.8.6 Moving through continuous text.** Scrolling, not panning, should be provided for moving through continuous text. [Source: MIL-HDBK-761A, 5.3.2.2.b, 5.3.2.2.1]

- **8.2.8.7 User search of grouped information.** Paging instead of panning or scrolling shall be used for a user search of logically grouped information such as data forms. [Source: CTA, 1996 - 6.1.1.3.2]

  Discussion. Although experienced computer users perform equally well with paging or scrolling for logically grouped information, inexperienced computer users tend to perform better with using a paging method. Thus, when both experienced and inexperienced users will be using the application, use of paging is the better method.

8.2.9 Lists

- **8.2.9.1 Lists.** A series or list of text elements should be presented vertically, not horizontally. [Source: DOE HFDG ATCCS, V2.0, 10.3.3.6; DOD HCISG V2.0, 4.2.3.3.f]

- **8.2.9.2 Display of lists.** A series of related items should be displayed as a list to support quick, accurate scanning. [Source: CTA, 1996 - 3.5]

- **8.2.9.3 Number of columns.** A single column should be used for a list, with each item in the list starting in a new row. [Source: CTA, 1996 - 3.5.1]

- **8.2.9.4 Multiple columns.** For a more compact display of a long list, designers should use multiple columns with items ordered vertically within each column. [Source: CTA, 1996 - 3.5.1.1]

- **8.2.9.5 Order of items.** Designers should base the order of items on natural rationale such as frequency of use, related functionality, or the normal sequence of user actions. [Source: CTA, 1996 - 3.5.2]

- **8.2.9.6 Consistent rationale.** Designers should maintain the same rationale for the order of items for each instance of a particular list. [Source: CTA, 1996 - 3.5.2]

- **8.2.9.7 Alphabetical order.** When there is no apparent logical basis for ordering items, then the items should be listed alphabetically. [Source: CTA, 1996 - 3.5.2]

- **8.2.9.8 Vertical list extension beyond one page.** Where lists extend over more than one page, the last line of one page should be the first line on the succeeding page. [Source: Nuclear Regulatory Commission, 1996 - 1.2.2-17]

- **8.2.9.9 Hierarchic structure for long lists.** For a long list extending more than one displayed page, a hierarchic structure should be used to permit its logical partitioning into related shorter lists. [Source: Nuclear Regulatory Commission, 1996 - 1.2.2-18]

- **8.2.9.10 Numbering items on multi-display lists.** When the items in a numbered list do not all fit on one display, the entire set of items shall be numbered continuously and not start anew with each display. [Source: MIL-HDBK-761A, 5.3.2.3.f]

- **8.2.9.11 Numbering items on a list.** Arabic numerals (not Roman) shall be used when numbering items on a list. [Source: National Air Traffic Services, 1999 - 1.11.17.3]

8.2.10 Tables

- **8.2.10.1 When to use.** When sets of data must be entered sequentially or when data are keyed row by row, a tabular format should be used. [Source: MIL-HDBK-761A, 5.2.5.a]

- **8.2.10.2 Structure.** Ordering of columns in tables should proceed with an index (if used) on the leftmost edge of the display followed by the most important column, and so on. [Source: Ameritech Services Inc., 1998 - 4.6.2]

  > **Example.** When the table is organized alphabetically (by last name), place the last name in the column on the far left, with the rest of the columns (e.g., first name and address.) from left to right according to their significance to the task. [Source: Ameritech Services Inc., 1998 - 4.6.2]

- **8.2.10.3 Large tables.** When a table is too large to fit in the available display area, as much of the top left portion as will fit shall be initially displayed, and appropriate scroll-bars or similar mechanisms be provided to give the user the capability to determine the data that show up in the table. [Source: MIL-HDBK-761A, 5.2.5.2.b]

- **8.2.10.4 Scroll-bars on large tables.** Scroll-bars should be provided on the right or left side and on the bottom or top of large tables that require scrolling. [Source: MIL-HDBK-761A, 5.2.5.2.b]

- **8.2.10.5 Arrangement in scrolling tables**. Rows and columns shall be arranged according to some logic, for example, chronologically or alphabetically. [Source: CTA, 1996 - 3.4.3]

- **8.2.10.6 Compared columns**. Columns that will be compared often by the users should be located near one another. [Source: Ameritech Services Inc., 1998 - 4.6.2]

- **8.2.10.7 Scanning cues.** Adequate separation shall be provided between columns and between groups of rows. [Source: CTA, 1996 - 3.4.4]

  Example. To increase readability, insert at least three spaces between columns and a blank line after every fifth row.

- **8.2.10.8 Unique labels.** Each row and column shall be uniquely and informatively labeled, and the labels shall be distinct from the data cells. [Source: MIL-HDBK-761A, 5.2.5.2]

- **8.2.10.9 Row and column headings.** Row and column labels or headings shall reflect information the user had before consulting the table (the user's perspective, information, and language). [Source: CTA, 1996 - 3.4.2]

- **8.2.10.10 Labels in scrolling tables.** When a user scrolls a large table, the row or column labels that remain relevant shall not scroll but shall remain in place. [Source: MIL-HDBK-761A, 5.2.5.2.b, 5.2.5.2.c]

  Example. When the rows scroll up or down, the column labels shall remain in place. [Source: MIL-HDBK-761A, 5.2.5.2.b, 5.2.5.2.c]

- **8.2.10.11 Leading and trailing zeros.** Users shall not have to type leading zeros (before numbers to the left of the decimal point) or trailing zeros (following numbers to the right of the decimal point) when entering numeric data into a table. [Source: MIL-HDBK-761A, 5.2.5.d]

- **8.2.10.12 Automatic justification.** Data typed into a cell of a table shall be justified automatically when the user moves the cursor to the next cell with justification as follows: [Source: MIL-HDBK-761A, 5.2.5.b, 5.2.5.c]

  a. Alphanumeric input left justified.

  b. Integer numerical data right justified.

  c. Decimal numerical data decimal point justified. [Source: MIL-HDBK-761A, 5.2.5.b, 5.2.5.c]

- **8.2.10.13 Navigation with the Tab key.** The **Tab** key shall move the cursor to the first position of the next cell to the right of its current position, or, if the current position is in the last cell in a row, to the first position of the first cell in the next row. [Source: MIL-HDBK-761A, 5.2.5.1]

- **8.2.10.14 Navigation using Shift and Tab keys.** Pressing **Shift** and **Tab** simultaneously shall move the cursor to the first position in the next cell to the left of the current position, or, if the current position is in the first cell in a row, to the first position in the last cell in the preceding row. [Source: MIL-HDBK-761A, 5.2.5.1]

- **8.2.10.15 Navigation.** The user shall be allowed to move through a table using the arrow keys. [Source: Ameritech Services Inc., 1998 - 4.6.3]

8.2.11 Forms

Form filling as a means of data entry is especially appropriate if some flexibility is needed (e.g., the inclusion of optional as well as required items), if users will have moderate training, or if computer response might be slow.

8.2.11.1 General

- **8.2.11.1.1 Title.** Each form shall have a title located at the top of the form. [Source: DOE HFDG ATCCS, V2.0, 3.7.7]

- **8.2.11.1.2 Consistency.** Forms, labels, fields, messages, and instructions that appear on different displays shall be as consistent as possible within an application and among related applications. [Source: DOE HFDG ATCCS, V2.0, 3.5.2, 3.8.3.]

- **8.2.11.1.3 Field Help.** Help shall be provided for fields. [Source: DOE HFDG ATCCS, V2.0, 3.7.3]

  Discussion. Some Help might be provided automatically when the cursor arrives in a field, such as an explanatory message or a menu of acceptable entries. Other ways context-sensitive Help might be provided include providing a Help operation that provides Help on the field that contains the cursor and providing Help on the field when a user moves the pointer onto the field label and clicks the appropriate button. [Source: DOE HFDG ATCCS, V2.0, 3.7.3]

- **8.2.11.1.4 Grouping and sequencing**. Groups and sequences in a form should reflect the way the user performs the task. [Source: Ameritech Services Inc., 1998 - 4.1]

8.2.11.2 Fields

- **8.2.11.2.1 Appearance.** Fields shall have a distinctive appearance and distinct limits. [Source: DOE HFDG ATCCS, V2.0, 3.5.5, 3.7.5; MIL-HDBK-761A, 5.2.4.1.1.b]

  Example. A series of underscores or a rectangle perhaps in inverse video can be used to clearly distinguish fields from each other and from other objects and information on the screen. [Source: DOE HFDG ATCCS, V2.0, 3.5.5, 3.7.5; MIL-HDBK-761A, 5.2.4.1.1.b]

- **8.2.11.2.2 Field length.** Data entry fields should be of fixed length, even if the entries may be of variable length. If useful to the user, a field should give a cue as to its length, for example, by using separated underscores (_ _ _ _ _). [Source: DOE HFDG ATCCS, V2.0, 3.5.7]

- **8.2.11.2.3 Entry does not overwrite field delineators.** Characters that are overwritten as a user enters data shall not designate fields. [Source: DOE HFDG ATCCS, V2.0, 3.5.8; MIL-HDBK-761A, 5.2.4.1.1.c]

- **8.2.11.2.4 Unfilled portion of field.** When a field accepts variable length entries, users shall not have to remove or fill any unneeded portion. [Source: MIL-HDBK-761A, 5.2.4.1.1.d]

- **8.2.11.2.5 Multiple required fields.** When a form has one or more required field, the user shall have to make an entry in each required field to be able to complete the form as intended. [Source: DOE HFDG ATCCS, V2.0, 3.7.10]

- **8.2.11.2.6 Disabled Save option.** When a form has one or more required field, the **Save** option shall be displayed as unavailable until all of the required fields have been filled. [Source: DOE HFDG ATCCS, V2.0, 3.7.10]

  Examples. A user might be given an error message if he or she tries to leave a required field without making an entry, or a user might be given an error message if he or she tries to **Save** a form without making an entry in all required fields. [Source: DOE HFDG ATCCS, V2.0, 3.7.10]

- **8.2.11.2.7 Optional fields distinct from required fields.** When a form has both optional and required fields, the two types of fields shall be easily distinguishable. [Source: DOE HFDG ATCCS, V2.0, 3.7.8; MIL-HDBK-761A, 5.2.4.1.1.e; ESD-TR-86-278,1.4.12]

  Examples. One way to do this would be to use different label terminators for the two types of fields. For example, the labels of optional fields might be followed by a colon (:), and the labels of required fields might be followed by a slash (/). Another way would be to use different appearances for the fields themselves. For example, a required field might appear as underscores (____) and an optional field as a row of dots (.....). [Source: DOE HFDG ATCCS, V2.0, 3.7.8; MIL-HDBK-761A, 5.2.4.1.1.e; ESD-TR-86-278,1.4.12]

- **8.2.11.2.8 Intra-field separators.** When possible, fields provided for data that include separators or some sort of formatting (e.g., slashes separating the month, day, and year in dates or a decimal point separating dollars and cents) shall include the separators or formatting as part of the field. [Source: DOE HFDG ATCCS, V2.0, 3.5.4; MIL-HDBK-761A, 5.2.4.1.1.a; ESD-TR-86-278, 1.4.3, 1.4.20]

  Examples. A field for a date might appear:
  DATE: __/__/__.

  A field for a telephone number might appear:
  TELEPHONE NUMBER: (___) ___-____.

8.2.11.3 Text fields

- **8.2.11.3.1 When to use.** When a user must be able to type input from the keyboard, a text field shall be provided. [Source: DON UISNCCS, V1.2, 6.4]

- **8.2.11.3.2 Scrolling fields.** When a text field will accept more text than can be displayed in the field, a scroll-bar shall be provided to enable users to see the entire text. [Source: DON UISNCCS, V1.2, 6.4]

- **8.2.11.3.3 Multiple lines of text.** When the anticipated text is expected to exceed a single line, the text field shall be large enough to view multiple lines simultaneously. [Source: DON UISNCCS, V1.2, 6.4]

8.2.11.4 Field labels

- **8.2.11.4.1 Field labels.** Every data field shall have a label that uniquely identifies the field. [Source: DOE HFDG ATCCS, V2.0, 3.5.6, 3.8.1; MIL-HDBK-761A, 5.2.4.1.2.a]

  Discussion. A single label is sufficient for a series of fields of the same type arrayed in a row or column. [Source: DOE HFDG ATCCS, V2.0, 3.5.6, 3.8.1; MIL-HDBK-761A, 5.2.4.1.2.a]

- **8.2.11.4.2 Labels distinct from other information.** Labels shall be distinct from data entries and from other information on the screen including text boxes, control options, and messages. [Source: MIL-HDBK-761A, 5.2.4.1.2.a]

  Example. Do not place boxes around labels, which can make them appear to be text boxes. Instead, labels can be differentiated by font or size.

- **8.2.11.4.3 Labels not editable.** Field labels shall not be editable by users, at least not while they are in form-filling mode. [Source: MIL-HDBK-761A, 5.2.4.1.2.d]

- **8.2.11.4.4 Case options.** For legibility, labels should be displayed consistently in either all capitals or in mixed cases, with the first letter of the word capitalized. [Source: CTA, 1996 - 3.8.1.2]

- **8.2.11.4.5 Consistent content.** Throughout form filling and database entry, label content shall consistently be relevant to the group of users. [Source: Ameritech Services Inc., 1996 - 4.3.1.1.3]

- **8.2.11.4.6 Standard characters.** Labels should be constructed using only standard alphabetic characters, avoiding contractions, hyphenations, and abbreviations. [Source: Ameritech Services Inc., 1996 - 4.3.1.1.3]

  Exception. Abbreviations can be used when they are in common usage and easily understood by all users of the application.

- **8.2.11.4.7 Descriptive labels.** A label should specify or suggest the entry that goes into the field. Numbers and other arbitrary codes should not be used as field labels. [Source: MIL-HDBK-761A, 5.2.4.1.2.f]

  Discussion. Complete words are preferred as labels, but predefined terms, codes, and abbreviations may be acceptable. [Source: MIL-HDBK-761A, 5.2.4.1.2.f]

- **8.2.11.4.8 Terms used in labels.** Labels for data fields should be composed of terms that are familiar to the user, relevant to the topic of the form, and easily understood by a typical user. [Source: DOE HFDG ATCCS, V2.0, 3.8.5, 3.8.6]

- **8.2.11.4.9 Label terminator.** Field labels shall terminate with a special symbol that designates the end of the label and the beginning of the field (a colon ":" is frequently used for this purpose) or, a blank space that follows the terminator and separates it from the beginning of the field when the label is to the left of the field. [Source: DOE HFDG ATCCS, V2.0, 3.8.2; MIL-HDBK-761A, 5.2.4.1.2.e]

- **8.2.11.4.10 Consistent location.** Labels shall be located consistently with respect to their fields. [Source: DOE HFDG ATCCS, V2.0, 3.8.2; MIL-HDBK-761A, 5.2.4.1.2.b]

  Discussion. The preferred location for a label is to the left of or above its field. When a form contains both single label-field pairs and arrays (rows or columns) of fields with a single label, the location of labels for the single label-field pairs may be different from the labels for the arrays of fields. [Source: DOE HFDG ATCCS, V2.0, 3.8.2; MIL-HDBK-761A, 5.2.4.1.2.b]

- **8.2.11.4.11 Unit of measurement.** When a field entry involves a unit of measurement, the unit shall be included as part of the label or field. [Source: DOE HFDG ATCCS, V2.0, 3.8.7; MIL-HDBK-761A, 5.2.4.1.2.1.a; ESD-TR-86-278, 1.4.21]

  Examples.

  COST: $_____.__

  LENGTH (ft): _____

- **8.2.11.4.12 Alternative units.** When measurements might be in different units, for example, inches or millimeters, users shall not have to transform them at the time of data entry. [Source: MIL-HDBK-761A, 5.2.4.1.2.1.c, 5.2.4.1.2.1.d]

  Discussion. Providing a field for each unit of measurement, where the user selects the correct field, might solve this problem. Another solution might be to have one field for the quantity and another field for the unit of measurement. [Source: MIL-HDBK-761A, 5.2.4.1.2.1.c, 5.2.4.1.2.1.d]

- **8.2.11.4.13 Displaying labels.** Labels shall be displayed in a left-to-right (horizontal) orientation as opposed to vertically or in any other off-horizontal orientation. [Source: CTA, 1996 - 3.8.3]

- **8.2.11.4.14 Field label spacing.** Labels shall be separated from one another by at least two standard character spaces. [Source: CTA, 1996 - 3.8.5]

8.2.11.5 Layout

- **8.2.11.5.1 Correspondence between screen and document.** When users will transfer data from hard copy documents, the screen layout shall correspond to the hard copy in the order and grouping of data items. For this case, it is desirable that the displayed form look as much like the source document as possible. [Source: DOE HFDG ATCCS, V2.0, 3.5.6, 3.8.1; MIL-HDBK-761A, 5.2.4.1.2.a]

- **8.2.11.5.2 Layout with no source document.** When input is not from source documents or hard copy forms, data fields shall be ordered and grouped logically using sequence, frequency of use, importance, and functional associations as organizing principles. [Source: DOE HFDG ATCCS, V2.0, 3.7.2, 3.7.6; MIL-HDBK-761A, 5.2.4.1.c]

- **8.2.11.5.3 Multi-page forms.** When a form is too large to fit in the available screen area, it should be broken into pages, and each page should be labeled with its number and the total number (e.g., **Page 1 of 3).** [Source: DOE HFDG ATCCS, V2.0, 3.7.1]

8.2.11.6 Navigation

- **8.2.11.6.1 Initial cursor position.** When a form first appears, the cursor shall be placed automatically in the first position of the first field. [Source: DOE HFDG ATCCS, V2.0, 3.4.5; MIL-HDBK-761A, 5.2.4.2.a]

- **8.2.11.6.2 Easy cursor movement.** The system shall provide one or more easy ways to move the cursor among fields. [Source: DOE HFDG ATCCS, V2.0, 3.4.2]

- **8.2.11.6.3 Movement with keyboard.** When the primary means of entering data in fields is the keyboard, the cursor movement methods shall include keyboard keys such as the **Tab** key(s) and the arrow keys. [Source: DOE HFDG ATCCS, V2.0, 3.4.2]

- **8.2.11.6.4 Movement with pointing device.** When a pointing device is available, a user shall be able to move the cursor to any field by moving the pointer into the field and clicking the appropriate button. [Source: DOE HFDG ATCCS, V2.0, 3.4.2]

- **8.2.11.6.5 Multiple devices.** When both a keyboard and pointing device is available, cursor movement shall be allowed using either device. [Source: DOE HFDG ATCCS, V2.0, 3.4.2]

- **8.2.11.6.6 No automatic movement.** The cursor should not be moved automatically among fields with movement occurring only upon explicit user action, such as pressing the **Tab** key. [Source: DOE HFDG ATCCS, V2.0, 3.4.3]

  Exception. There may be cases in which automatic movement is desirable. For example, if skilled users enter numerous entries of fixed length, it may be preferable to move the cursor automatically to the next field when the current field is filled. The danger is that a missed or extra character may result in erroneous entries in many fields before the user notices. [Source: DOE HFDG ATCCS, V2.0, 3.4.3]

- **8.2.11.6.7 Navigation only to fields.** A user shall be able to move the cursor only into fields and onto control objects on the screen, not onto labels or other non data-entry areas. [Source: DOE HFDG ATCCS, V2.0, 3.4.1]

- **8.2.11.6.8 Protected fields.** When a form has protected fields, a user shall not be able to move the cursor into a protected field. [Source: MIL-HDBK-761A, 5.2.4.2.e]

  Explanation. A field might be protected from some users and not from others. Other fields might be reserved for the display of computed values. [Source: MIL-HDBK-761A, 5.2.4.2.e]

- **8.2.11.6.9 Moving to next and previous fields.** When the fields in a form will be traversed sequentially, a user should be able to move the cursor to the next field by pressing the **Tab** key and to the previous field by pressing the **Shift** and **Tab** keys simultaneously. [Source: MIL-HDBK-761A, 5.2.4.2.c]

  Discussion. This sort of movement requires a predefined path through a form that specifies which field is next and which is previous. Presumably, such a path will traverse each field once and only once in a systematic way, for example, from left to right and top to bottom. [Source: MIL-HDBK-761A, 5.2.4.2.c]

- **8.2.11.6.10 Navigation with a pointer.** When fields may not necessarily be traversed in a set order, a pointing device in addition to keyboard should also be available for selecting fields. [Source: MIL-HDBK-761A, 5.2.4.2.d]

8.2.11.7 Defaults

- **8.2.11.7.1 When to use.** When a form is expected to have the same entry in a particular field most of the time, that entry should appear in that field as a default entry when the form first appears. [Source: Smith & Mosier, 1986 – 1.8/1]

- **8.2.11.7.2 Displaying default values.** A field that has a default value shall have that value appear in the field automatically when the form appears. [Source: DOE HFDG ATCCS, V2.0, 3.2.1]

- **8.2.11.7.3 Replacing default values in fields.** When an entry is normally made in a field by typing, a user shall be able to replace that value by moving the cursor into that field and typing causing the default value to disappear immediately after the first keystroke. [Source: DOE HFDG ATCCS, V2.0, 3.2.2]

- **8.2.11.7.4 Retaining default value.** When a default value is replaced, the default value itself shall not be affected so that the next time the form appears, the same default value will appear in the field. [Source: DOE HFDG ATCCS, V2.0, 3.2.2]

  Exception. An exception to this rule is when an application permits a user to select whether he or she wants the application to retain the last entry or a previous default value as the current default setting. [Source: DOE HFDG ATCCS, V2.0, 3.2.2]

8.2.11.8 Error management

- **8.2.11.8.1 Easy error correction.** Users shall be able to correct errors easily on a character-by-character and field-by-field basis. [Source: DOE HFDG ATCCS, V2.0, 3.6.1]

- **8.2.11.8.2 Unacceptable entries.** When a field has a set or range of acceptable values and a user enters an unacceptable value, the system shall either

  a. provide an error message when the user tries to leave the field and not move the cursor from the field; or

  b. allow the user to continue moving through the form and, when the user tries to perform the completion action, provide an error message and move the cursor to the field in error. [Source: DOE HFDG ATCCS, V2.0, 3.6.2]

- **8.2.11.8.3 Omitted fields.** When a user fails to make an entry in a required field, the system shall either

  a. provide an error message when the user tries to leave the field and not move the cursor from the field; or

  b. allow the user to continue moving through the form and, when the user tries to perform the completion action, provide an error message and move the cursor to the field in error. [Source: MIL-HDBK-761A, 5.2.4.1.d]

- **8.2.11.8.4 Deliberate omissions.** When applicable, a system or application should provide a special symbol that a user can enter in a required field. This symbol will allow the user to defer the required entry and continue with the remainder of the form. [Source: DOE HFDG ATCCS, V2.0, 3.5.3]

- **8.2.11.8.5 Distinctive fields.** Data fields should be visually distinguishable from other displayed information. [Source: MIL-HDBK-761A, 5.3.1.5.1.h]

8.3 Graphical information

8.3.1 General

- **8.3.1.1 Value display.** When appropriate, users should be able to select a data point on a graph and obtain a display of the associated value or values. [Source: DOE HFDG ATCCS, V2.0, 9.1.6]

  Discussion. Users might also be given the option of choosing between tabular and graphical displays. [Source: DOE HFDG ATCCS, V2.0, 9.1.6]

- **8.3.1.2 Consistency.** Graphics shall be consistent in design, format, and labeling throughout an application and related applications. [Source: DOE HFDG ATCCS, V2.0, 9.1.8]

  Example. When graphic data are labeled, the text would appear in a consistent location in relation to the graphic elements. [Source: DOE HFDG ATCCS, V2.0, 9.4.4]

- **8.3.1.3 Labels.** Displayed graphics shall be clearly labeled. [Source: DOE HFDG ATCCS, V2.0, 9.1.9]

- **8.3.1.4 Robustness.** Graphics should be designed to remain useful when reproduced or reduced in size. [Source: DOE HFDG ATCCS, V2.0, 9.1.2]

- **8.3.1.5 Reference values.** When users are required to make comparative evaluations against reference values, the reference values shall be displayed. [Source: DOE HFDG ATCCS, V2.0, 9.4.1]

- **8.3.1.6 Displaying data values with graphics.** When precise readings of values are required, the actual data values should be displayed in addition to the plotted data. [Source: DOE HFDG ATCCS, V2.0, 9.4.3]

- **8.3.1.7 Supplementary text.** The use of supplementary text should be minimized and used only within the framework of the graph to emphasize features of data requiring user attention or to enhance user understanding. [Source: DOE HFDG ATCCS, V2.0, 9.4.2]

8.3.2 Maps and tactical displays

8.3.2.1 Characteristics

- **8.3.2.1.1 Map visibility.** When important for task performance and to the extent possible, other displays such as dialog boxes and windows should not obscure a map display. [Source: DOE HFDG ATCCS, V2.0, 8.5.2]

- **8.3.2.1.2 Map cursor.** The cursor in a map display should be a cross-hair design that has a high contrast with the background and subtend a visual angle of at least 20 minutes of arc. [Source: DOE HFDG ATCCS, V2.0, 8.5.3]

- **8.3.2.1.3 Intensity.** The intensity of the map should be controllable to allow the map to be dimmed without losing all the map features. [Source: DOE HFDG ATCCS, V2.0, 8.5.4.1]

- **8.3.2.1.4 Map as background.** When an application uses one map intensively, it is recommended that the map be used as the background or base screen, which should be the maximum display size possible to promote readability. [Source: DOE HFDG ATCCS, V2.0, 8.5.1]

- **8.3.2.1.5 Map size.** Map displays shall be large enough to permit the simultaneous presentation and visual integration required by users. [Source: DOE HFDG ATCCS, V2.0, 8.2.1]

- **8.3.2.1.6 Map coverage.** Maps shall cover the areas and display all the essential features and details users need to perform their tasks. [Source: DOE HFDG ATCCS, V2.0, 8.2.1]

- **8.3.2.1.7 Context for displayed map.** When a displayed map is not the entire map, an inset should be provided that shows the entire map with the displayed portion highlighted. [Source: DOE HFDG ATCCS, V2.0, 8.2.4.2]

- **8.3.2.1.8 Curvature.** When large geographic areas are displayed, the curvature of the earth should be treated consistently in all displays. [Source: DOE HFDG ATCCS, V2.0, 8.1.1]

- **8.3.2.1.9 Automatic registration.** The system should provide automatic registration of graphic data with background map information at all display scales. [Source: DOE HFDG ATCCS, V2.0, 8.2.2.2]

- **8.3.2.1.10 Situation displays as overlays.** Situation displays should be provided as overlays to their related maps. [Source: DOE HFDG ATCCS, V2.0, 8.1.2]

- **8.3.2.1.11 Consistent orientation.** When more than one map will be displayed, all maps should have the same orientation, usually with north at the top. [Source: DOE HFDG ATCCS, V2.0, 8.1.4]

- **8.3.2.1.12 Coding areas of special interest.** Map areas of special interest should be coded by color or shading. [Source: DOE HFDG ATCCS, V2.0, 8.1.5]

- **8.3.2.1.13 Coding for compared areas.** When users must make relative comparisons among areas, shades of a single color should be used rather than different colors, with the gradation from light to dark corresponding to the variation represented by the shades. [Source: DOE HFDG ATCCS, V2.0, 8.1.5]

- **8.3.2.1.14 Reading a map.** Users should be provided with a means for easily determining distance and bearing between any two points on a map. [Source: DON UISNCCS, V1.2, 9.6.2]

- **8.3.2.1.15 Automated tools.** When users must perform complex analyses of maps, the system should provide the specific, automated tools they need. [Source: DOE HFDG ATCCS, V2.0, 8.1.6]

  > **Example.** The system might provide an automated program that prioritizes all alarms displayed on a map. [Source: DOE HFDG ATCCS, V2.0, 8.1.6]

- **8.3.2.1.16 Labeling features.** To the extent possible without cluttering the display, all significant features should be labeled. [Source: DOE HFDG ATCCS, V2.0, 8.1.3]

- **8.3.2.1.17 Consistent label position.** Map labels should be positioned consistently with respect to the feature they identify, for example, to the left of or below the feature but without obscuring important information. [Source: DON UISNCCS, V1.2, 9.6.1]

- **8.3.2.1.18 Label legibility.** Labels shall remain legible at all display resolutions. [Source: DOE HFDG ATCCS, V2.0, 8.2.1.2]

- **8.3.2.1.19 Labeling symbols.** Critical symbols should be labeled automatically. [Source: DOE HFDG ATCCS, V2.0, 8.2.3.5]

- **8.3.2.1.20 Displaying information about symbols.** Users should have a means for displaying identifying information about unlabeled symbols. [Source: DOE HFDG ATCCS, V2.0, 8.2.3.5]

- **8.3.2.1.21 Association of symbols with map features.** A symbol should be placed accurately with respect to the map feature with which it is associated or connected to the feature with an arrow, line, or other pointing device so that the association between feature and symbol is clear. [Source: DOE HFDG ATCCS, V2.0, 8.2.2.1]

- **8.3.2.1.22 Color-coding symbols.** Color-coding of symbols shall conform to the criteria and guidelines for color. [Source: DOE HFDG ATCCS, V2.0, 8.2.3.3]

- **8.3.2.1.23 Color in overlays.** When color is used in overlays, it shall conform to the color criteria and guidelines. [Source: DOE HFDG ATCCS, V2.0, 8.5.5]

- **8.3.2.1.24 Color-coding key**. When a color overlay is available for a map, a color-coding key that explains each color should be displayed whenever the overlay is displayed. [Source: DON UISNCCS, V1.2, 9.6.1]

- **8.3.2.1.25 Text integrated with overlays.** Text on maps should be integrated with overlays so that the overlay does not obscure the text. [Source: DOE HFDG ATCCS, V2.0, 8.5.4.2]

- **8.3.2.1.26 Connecting text to features.** When the text is offset from the feature to which it refers, it should be connected to the feature with a line or arrow. [Source: DOE HFDG ATCCS, V2.0, 8.5.4.2]

- **8.3.2.1.27 No overlapping of symbols.** Map symbols should not overlap, particularly if overlapping would obscure their identity. [Source: DOE HFDG ATCCS, V2.0, 8.2.3.4]

- **8.3.2.1.28 Revealing obscured symbols.** When overlap is unavoidable, users should have a means of revealing obscured symbols. [Source: DOE HFDG ATCCS, V2.0, 8.2.3.4]

- **8.3.2.1.29 Selecting a symbol on a dense map.** When symbols on a map are densely packed or overlapped, users should have a way to select the desired symbol easily and accurately (e.g., by selecting it from a pop-up menu). [Source: DON UISNCCS, V1.2, 9.6.2]

- **8.3.2.1.30 Distinguishing among symbols.** Users should be able to distinguish among symbols that represent coincident points and to obtain information that will allow them to resolve ambiguities among symbols. [Source: DON UISNCCS, V1.2, 9.6.2]

- **8.3.2.1.31 User editing of labels and overlays.** When authorized, users should be able to **Add**, **Edit**, **Reposition**, and **Delete** labels and overlays on a map. [Source: DON UISNCCS, V1.2, 9.6.2]

- **8.3.2.1.32 Reducing clutter.** Users should be provided with a means for reducing clutter without losing essential information, such as the use of filters. [Source: DOE HFDG ATCCS, V2.0, 8.2.1.3; DOE HFDG ATCCS, V2.0, 8.5.4.1]

  > **Example.** Users can use a filter to reduce the clutter of a map display by filtering out such things as overlays, roads, cities, vegetation, and topography. [Source: DOE HFDG ATCCS, V2.0, 8.5.4.1]

- **8.3.2.1.33 Filters.** The labels and titles of filters should communicate their function clearly to users. [Source: DOE HFDG ATCCS, V2.0, 8.5.4.1]

- **8.3.2.1.34 Coordinate readings.** When location information will be needed frequently, users should have the option of a constant coordinates in units of their choosing. [Source: DOE HFDG ATCCS, V2.0, 8.2.4]

- **8.3.2.1.35 Overlay coordinates.** Users should be able to specify cursor coordinates for the placement of an overlay. [Source: DOE HFDG ATCCS, V2.0, 8.2.4]

- **8.3.2.1.36 Determining coordinates.** Users should be able to obtain the exact map coordinates of any symbol or map feature. [Source: DOE HFDG ATCCS, V2.0, 8.2.4.1]

8.3.2.2 Graphic display manipulation

- **8.3.2.2.1 User control of map appearance.** Users should be able to customize a map to conform to the task being performed. Methods include

  a. pan and zoom,

  b. return to initial appearance,

  c. define a home position and return to this position easily,

  d. move a map window,

  e. define the map appearance (e.g., assign colors to areas), and

  f. select the objects that appear on the map and change the appearance of critical information. [Source: DON UISNCCS, V1.2, 9.6.2]

- **8.3.2.2.2 Map manipulation tools.** The system should provide users with all appropriate tools for moving easily around a map, including zooming and panning as well as insets, registration, and keys for scale. [Source: DOE HFDG ATCCS, V2.0, 8.0]

- **8.3.2.2.3 Panning.** When it is required by their tasks, users should be able to move (pan) the viewpoint or window over the entire map in any direction. As long as it meets users' needs, panning may be either continuous or discrete. [Source: DOE HFDG ATCCS, V2.0, 8.3.1.1]

  Definition. Panning is an orientation of display framing in which a user conceives of the display frame as moving over a fixed array of data.

- **8.3.2.2.4 Location information.** Users should be provided feedback on the relative location of the displayed portion during panning and zooming operations. [Source: DOE HFDG ATCCS, V2.0, 8.3.1.2]

  Example. The currently displayed portion might be highlighted on an inset display of the entire map. [Source: DOE HFDG ATCCS, V2.0, 8.3.1.2]

- **8.3.2.2.5 Return to start.** When panning is provided, users should have the ability to return to the starting configuration quickly and easily. [Source: DOE HFDG ATCCS, V2.0, 8.3.1.3]

- **8.3.2.2.6 Zooming.** Users should be able to zoom a display in and out, that is, increase and decrease the portion of the entire map displayed on the screen. [Source: DOE HFDG ATCCS, V2.0, 8.3.2.1]

- **8.3.2.2.7 Zooming and legibility.** Zooming in and out shall not interfere with the ability of users to read symbols, labels, and other map features. [Source: DOE HFDG ATCCS, V2.0, 8.3.2.2]

  Discussion. It may be appropriate to vary the amount of detail displayed in accordance with the degree of zooming used. [Source: DOE HFDG ATCCS, V2.0, 8.3.2.2]

- **8.3.2.2.8 Discrete vs. continuous zooming.** The method of zooming provided, discrete or continuous should be acceptable to the users. [Source: DOE HFDG ATCCS, V2.0, 8.3.2.4]

- **8.3.2.2.9 Return to default.** When zooming is provided, an easy means to return to the default display should also be provided. [Source: DOE HFDG ATCCS, V2.0, 8.3.2.5]

- **8.3.2.2.10 Indication of changing scale.** Displays that change scale during zooming should include an indicator that shows the current scale. [Source: DOE HFDG ATCCS, V2.0, 8.3.2.6]

- **8.3.2.2.11 Selecting information for updating.** When appropriate, users should be able to select categories of information that will be updated automatically on a map display. [Source: DOE HFDG ATCCS, V2.0, 8.3.3.1]

- **8.3.2.2.12 Stable reference elements.** When a map is updated automatically, it should contain some elements that remain stable that users can use as reference points. [Source: DOE HFDG ATCCS, V2.0, 8.3.3.2]

- **8.3.2.2.13 Identification of updates.** Users should have a means for easily identifying updates and changes to a displayed map. [Source: DOE HFDG ATCCS, V2.0, 8.3.3.3]

- **8.3.2.2.14 Critical changes.** Critical changes to a displayed map should be easily distinguishable from other changes. [Source: DOE HFDG ATCCS, V2.0, 8.3.3.3]

  Example. Critical changes might be highlighted and remain highlighted until acknowledged by a user. [Source: DOE HFDG ATCCS, V2.0, 8.3.3.3]

- **8.3.2.2.15 Control of frequency of updating.** When appropriate to the task, users should be able to control the frequency with which a display is updated. [Source: DOE HFDG ATCCS, V2.0, 8.3.3.4]

- **8.3.2.2.16 Rate of updating.** When the users must track the changes as they occur, the rate at which a display is updated should not exceed the perceptual abilities of its users. [Source: DOE HFDG ATCCS, V2.0, 8.3.3.5]

- **8.3.2.2.17 Freezing a dynamic display.** Where appropriate, users should be able to freeze a dynamic display, preventing further updates until the display is unfrozen. [Source: DOE HFDG ATCCS, V2.0, 8.3.3.6]

- **8.3.2.2.18 Frozen displays.** Frozen displays should include an indication of their frozen state. [Source: DOE HFDG ATCCS, V2.0, 8.3.3.6]

- **8.3.2.2.19 Resuming from frozen displays.** Users should be able to choose to resume updating from the current time or from the time the display was frozen. [Source: DOE HFDG ATCCS, V2.0, 8.3.3.6]

- **8.3.2.2.20 Resuming from time the display was frozen.** When users choose to resume updating from the time the display was frozen, the user should be alerted to the fact that these data are not current. [Source: DON UISNCCS, V1.2, 8.5.6]

  Discussion. When the display is resumed from the time that it was frozen, the information is out-of-date by the amount of time that the display was frozen.

- **8.3.2.2.21 Control of rate of sequencing.** When appropriate, users should be able to control the rate of display sequencing. [Source: DOE HFDG ATCCS, V2.0, 8.3.4.5]

  Definition. Display sequencing is a means of reducing clutter by displaying a series of partial displays (e.g., a map and a series of overlays) or of displaying data sequentially. It can also be used as a form of animation. [Source: DOE HFDG ATCCS, V2.0, 8.3.4.5]

- **8.3.2.2.22 Direction of sequencing.** When appropriate, users should be able to view sequential displays backwards as well as forwards. [Source: DOE HFDG ATCCS, V2.0, 8.3.4.3]

- **8.3.2.2.23 Viewing selected displays.** Users should be able to return quickly to a selected display in a sequence of displays. [Source: DOE HFDG ATCCS, V2.0, 8.3.4.4]

- **8.3.2.2.24 Grid overlay.** Users should be able to display and remove a grid overlay on a map. [Source: DOE HFDG ATCCS, V2.0, 8.3.5]

- **8.3.2.2.25 Integrated grid.** When present, a grid should be integrated with the coordinate system of the map. [Source: DOE HFDG ATCCS, V2.0, 8.3.5]

- **8.3.2.2.26 Map legend.** Map displays should have associated legends. [Source: DOE HFDG ATCCS, V2.0, 8.3.6]

- **8.3.2.2.27 Dynamic map legend.** When a map is dynamic, the legend should change as the map does so that the information (including such data as the map scale, cursor location, and status) is continuously relevant to the current display. [Source: DOE HFDG ATCCS, V2.0, 8.3.6]

8.3.2.3 Creating and editing map graphics

- **8.3.2.3.1 Standard symbol library.** Users should have available a library of standard symbols and a means of transferring and manipulating them. [Source: DOE HFDG ATCCS, V2.0, 8.4.1]

- **8.3.2.3.2 Labeling symbols.** Users should have an easy means for labeling symbols. [Source: DOE HFDG ATCCS, V2.0, 8.4.2]

  Discussion. It might be desirable to provide an automated feature that would aid the user in labeling symbols and enforcing labeling conventions. [Source: DOE HFDG ATCCS, V2.0, 8.4.2]

- **8.3.2.3.3 Tools for constructing symbols and overlays.** When appropriate, users should be provided with tools that would aid them in constructing new symbols and graphic overlays. [Source: DOE HFDG ATCCS, V2.0, 8.4.3]

- **8.3.2.3.4 Editing displays.** When appropriate, users should be able to add to and delete from displays symbols, labels, and other features without destroying background information. [Source: DOE HFDG ATCCS, V2.0, 8.4.5.1]

- **8.3.2.3.5 Expanding displays.** Users should be able to expand an area of a display when necessary for the accurate placement of critical data. [Source: DOE HFDG ATCCS, V2.0, 8.4.5.2]

- **8.3.2.3.6 Editing display elements.** Users should be able to perform the following editing operations on elements in map displays:

  a. **Select** elements on the display causing selected elements to be highlighted.[Source: DOE HFDG ATCCS, V2.0, 8.4.5.3]

  b. **Move** selected elements on the display. .[Source: DOE HFDG ATCCS, V2.0, 8.4.5.4]

  c. **Remove** and **Restore** selected elements on the display. .[Source: DOE HFDG ATCCS, V2.0, 8.4.5.5]

  d. **Name, Store,** and **Retrieve** graphic displays and elements. [Source: DOE HFDG ATCCS, V2.0, 8.4.5.9]

- **8.3.2.3.7 Identifying attributes.** When appropriate, users should be able to identify the currently selected attributes easily. [Source: DOE HFDG ATCCS, V2.0, 8.4.5.7]

- **8.3.2.3.8 Changing display attributes.** Users should be able to change the attributes of selected display elements. [Source: DOE HFDG ATCCS, V2.0, 8.4.5.8]

- **8.3.2.3.9 Changing display attributes by selection.** Users should be able to change display attributes such as color, symbols, and line types by selecting the attributes from displays rather than by naming the options. [Source: DOE HFDG ATCCS, V2.0, 8.4.5.6]

- **8.3.2.3.10 Print preview.** Users should be able to preview symbols and overlays before printing them. [Source: DOE HFDG ATCCS, V2.0, 8.4.4]

8.3.3 Graphs

8.3.3.1 Scales, labels, and coding

- **8.3.3.1.1 Standard conventions.** Scales shall conform to the following conventions:

  a. Values shall increase with distance from an origin.

  b. Independent variables shall be plotted along the horizontal axis.

  c. Dependent variables shall be plotted along the vertical axis. [Source: DOE HFDG ATCCS, V2.0, 9.3.1]

- **8.3.3.1.2 Consistent use of symbols.** Symbols, when used, shall be assigned unique meanings and used consistently throughout an application and related applications. [Source: DOE HFDG ATCCS, V2.0, 9.3.2]

- **8.3.3.1.3 Color and pattern coding.** When colors or patterns are used to fill enclosed areas, the following rules apply:

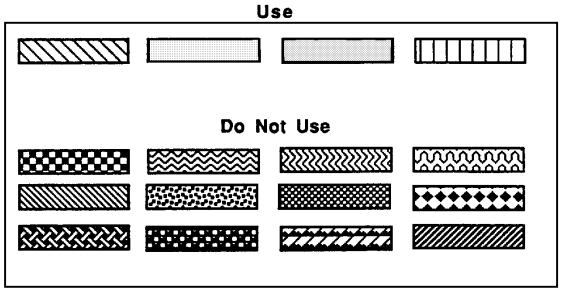
  a. Color-coding should be redundant with another form of coding.

  b. When the graphic is not likely to be printed, color should be used rather than patterning.

  c. When the graphic is likely to be printed, patterning should be used rather than color. [Source: DOE HFDG ATCCS, V2.0, 9.3.3]

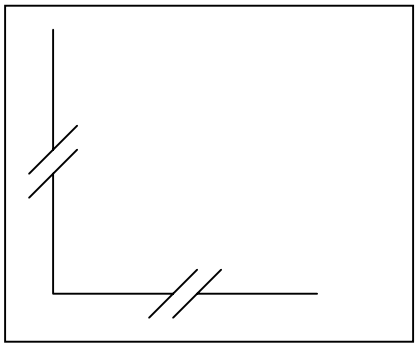
- **8.3.3.1.4 Patterns**. When patterns are used, they should be simple hatching and shading, not complex patterns that produce visual illusions of vibration or motion. Exhibit 8.3.3.1.4 illustrates acceptable and unacceptable patterns. [Source: DOE HFDG ATCCS, V2.0, 9.3.4]

Exhibit 8.3.3.1.4 Examples of acceptable and unacceptable patterns.



- **8.3.3.1.5 Breaks in axes.** When data are concentrated in a way that makes it desirable to show only a portion of an axis of a graph, the axis shall include the origin and be drawn with a break in it as illustrated in Exhibit 8.3.3.1.5. [Source: DOE HFDG ATCCS, V2.0, 9.3.5]

Exhibit 8.3.3.1.5 Example of axes with breaks.



- **8.3.3.1.6 One scale per axis.** Graphs should use only one scale on each axis as opposed to separate scales for separate curves of the graph. [Source: National Air Traffic Services, 1999 - 1.8.2.4.1.1]

- **8.3.3.1.7 Multiple scales on graphs.** When graphs with multiple scales must be used, an interactive display should be provided so that when a user selects a curve, the corresponding scale is highlighted. [Source: National Air Traffic Services, 1999 - 1.8.2.4.1.2, 1.8.2.4.1.3]

- **8.3.3.1.8 Duplicate axes.** When necessary to make a graph more readable, one or both of the horizontal and vertical axes should be repeated at the top or right of the graph, as appropriate. [Source: DOE HFDG ATCCS, V2.0, 9.3.6]

- **8.3.3.1.9 Consistent formats.** When separate graphs are to be compared or when different sets of data are to be plotted on the same graph, the formats and scales shall be identical. [Source: DOE HFDG ATCCS, V2.0, 9.3.8]

- **8.3.3.1.10 Labeling multiple curves.** When a single graph includes multiple curves, each curve should be clearly identified. [Source: National Air Traffic Services, 1999 - 1.8.2.3.2]

  Discussion. Curves can be identified by an adjacent label or by using color or line coding. [Source: National Air Traffic Services, 1999 - 1.8.2.3.2]

- **8.3.3.1.11 Linear scales.** In general, linear scales should be used rather than other types, such as logarithmic. [Source: DOE HFDG ATCCS, V2.0, 9.3.9, 9.3.10]

  Discussion. Logarithmic scales may be appropriate for comparing rates of change. [Source: DOE HFDG ATCCS, V2.0, 9.3.9, 9.3.10]

- **8.3.3.1.12 Circular scales.** For one-revolution circular scales, zero should be at 7 o'clock, and the maximum value should be at 5 o'clock, with a 60-degree break in the arc. [Source: Nuclear Regulatory Commission, 1996 - 1.3.6-4]

- **8.3.3.1.13 Single scale per axis.** An axis should represent only a single scale. [Source: DOE HFDG ATCCS, V2.0, 9.3.11]

- **8.3.3.1.14 Labeling axes.** Each axis shall have a label that describes the axis and its units of measurement. [Source: DOE HFDG ATCCS, V2.0, 9.3.12]

- **8.3.3.1.15 Tick marks.** Each axis shall have numbered or labeled tick marks corresponding to major scale divisions. [Source: DOE HFDG ATCCS, V2.0, 9.3.12]

- **8.3.3.1.16 Scale divisions.** Scales should not have more than 12 major scale divisions, and each major division should not be subdivided into more than 10 parts. [Source: DOE HFDG ATCCS, V2.0, 9.3.13]

- **8.3.3.1.17 Numeric scales.** Numeric scales shall begin with zero, cover the entire range of the data, and, when applicable, the major divisions labeled with decimal multiples of whole numbers. [Source: DOE HFDG ATCCS, V2.0, 9.3.14]

  Discussion. This rule prevents the distortion or misinterpretation of data that can result when the origin is omitted or if the scale does not continuously span the data range. It also helps make valid comparisons of different graphs possible. [Source: DOE HFDG ATCCS, V2.0, 9.3.14]

- **8.3.3.1.18 Labeling data elements.** Labels rather than legends or keys should be used to identify plotted data elements. [Source: DOE HFDG ATCCS, V2.0, 9.3.16]

- **8.3.3.1.19 Label format.** Labels should use upper and lowercase sans serif fonts. [Source: DOE HFDG ATCCS, V2.0, 9.3.15]

- **8.3.3.1.20 Label location.** They should be located adjacent to the elements they identify, and be oriented to permit normal left-to-right reading. [Source: DOE HFDG ATCCS, V2.0, 9.3.16]

  Discussion. When it is awkward to place the labels adjacent to the elements, they may be connected to the elements by arrows, lines, or other pointing conventions. [Source: DOE HFDG ATCCS, V2.0, 9.3.16]

- **8.3.3.1.21 Location of legends and keys.** When a graph requires a legend or key, the legend or key shall be located inside the rectangular bounds of the graph unless such a location would interfere with interpretation of the displayed data. [Source: DOE HFDG ATCCS, V2.0, 9.3.17]

8.3.3.2 Grid lines

The addition of grid lines to graphs can be helpful to users.

Definition. Grid lines are horizontal lines, vertical lines, or both extending from the scale divisions of one or both axes of a graph and intended to aid users in locating and reading data points.

- **8.3.3.2.1 When to use.** Grid lines should be used only when they are necessary to help users achieve a desired level of precision. [Source: DOE HFDG ATCCS, V2.0, 9.5.2]

- **8.3.3.2.2 Grid lines vs. data.** Grid lines should be easily distinguishable from data without obscuring data. [Source: DOE HFDG ATCCS, V2.0, 9.5.1]

- **8.3.3.2.3 User choice.** When grid lines are provided, they should be provided in a way that gives users the option of displaying them or not. [Source: DOE HFDG ATCCS, V2.0, 9.5.3]

8.3.3.3 Lines and curves

- **8.3.3.3.1 Use of lines and curves.** Straight lines between data points or smoothed curves through the points should be used to show relationships between two variables. [Source: DOE HFDG ATCCS, V2.0, 9.6.1.1]

- **8.3.3.3.2 Labeling multiple lines and curves.** When a graph contains more than one line or curve, each one should have an identifying label. [Source: DOE HFDG ATCCS, V2.0, 9.6.1.2, 9.6.1.3]

- **8.3.3.3.3 Order of legend.** When a legend is used to identify the lines in a graph, then, to the extent possible, the lines should appear in the legend in the same order they appear in the graph. [Source: DOE HFDG ATCCS, V2.0, 9.6.1.2, 9.6.1.3]

  Discussion. The preferred location for labeling a line or curve is adjacent to it, but, if the spacing of the lines or curves makes this difficult, it is acceptable to use a legend. [Source: DOE HFDG ATCCS, V2.0, 9.6.1.2, 9.6.1.3]

- **8.3.3.3.4 Highlighting critical lines and curves.** When one curve or line in a graph is critical, that one should be highlighted. [Source: DOE HFDG ATCCS, V2.0, 9.6.1.2, 9.6.1.3]

- **8.3.3.3.5 Coding lines and curves.** When lines and curves are coded to distinguish among multiple curves on the same graph, the coding shall be used consistently throughout an application and related applications for the same types of data. [Source: DOE HFDG ATCCS, V2.0, 9.6.1.4]

- **8.3.3.3.6 Display of projected values.** Curves representing values projected beyond the actual data set should be coded distinctly from curves representing actual data. [Source: DOE HFDG ATCCS, V2.0, 9.6.1.5; Nuclear Regulatory Commission, 1996 - 1.2.5-11]

- **8.3.3.3.7 Cyclic data.** When cyclic data are displayed, at least one full cycle should be presented. [Source: DOE HFDG ATCCS, V2.0, 9.6.1.6]

- **8.3.3.3.8 Trending time intervals.** Trend displays should be capable of showing data collected during time intervals of different lengths. [Source: Nuclear Regulatory Commission, 1996 - 1.2.5-7]

- **8.3.3.3.9 Multiple trend lines.** When the user must compare data represented by separate curves, the curves should be displayed in one combined graph. [Source: Nuclear Regulatory Commission, 1996 - 1.2.5-8]

- **8.3.3.3.10 Stability of trend data.** Trend rates should not vary as a result of minor fluctuations in data or oscillatory behavior that may be superimposed on a well-defined trend. [Source: Nuclear Regulatory Commission, 1996 - 1.2.5-9]

- **8.3.3.3.11 Indication of non-representative trend data.** It should be indicated to the user when the rate value, in a simple quantitative rate of change value, does not accurately represent the trend because of minor fluctuations or oscillations. [Source: Nuclear Regulatory Commission, 1996 - 1.2.5-10]

8.3.3.4 Areas

- **8.3.3.4.1 Area between curves.** When emphasis is on the area between two curves, that area should be filled with color or a pattern. [Source: DOE HFDG ATCCS, V2.0, 9.6.2.1]

- **8.3.3.4.2 Stacked curves.** When cumulative data are represented by stacked curves, the curves should be ordered with the least variable at the bottom and the most variable at the top. [Source: DOE HFDG ATCCS, V2.0, 9.6.2.2]

- **8.3.3.4.3 Labeling areas.** Areas in graphs should be labeled within the areas, to the extent possible. [Source: DOE HFDG ATCCS, V2.0, 9.6.2.3]

8.3.3.5 Scatter plots

- **8.3.3.5.1 When to use.** Scatter plots should be used to show the spatial distribution of points within a coordination system. [Source: DOE HFDG ATCCS, V2.0, 9.6.4]

  Discussion. Scatter plots are sometimes used to show dispersal intended to indicate non-correlation of variables. However, users will often perceive patterns in scattered data points where none actually exist. Curves can be superimposed on scatter plots (data plotted as points in a two-dimensional graph) to indicate computed data trends, correlations, or other derived statistical measures, thus combining two types of graphic display. [Source: Nuclear Regulatory Commission, 1996 - Table 1.2]

- **8.3.3.5.2 Highlighting points.** When a scatter plot contains points of particular importance, those points should be highlighted. [Source: DOE HFDG ATCCS, V2.0, 9.6.4]

- **8.3.3.5.3 Grouping scatter plots to show multiple relations.** When scatter plots are being examined to determine relationships among several variables, the scatter plots should be displayed as an ordered group (matrix) with each indicating the relation between just two variables. [Source: Nuclear Regulatory Commission, 1996 - 1.2.5-27]

- **8.3.3.5.4 Interactive analysis of grouped scatter plots.** When scatter plots are grouped in a single display to show relations among several variables, an interactive aid should be provided for analysis so that if a user selects a set of data in one plot then, the corresponding data points in other plots will be highlighted. [Source: Nuclear Regulatory Commission, 1996 - 1.2.5-28]

8.3.3.6 Bar charts and histograms

- **8.3.3.6.1 Labeling paired bars.** When bars are displayed in pairs, they should be labeled as a unit, with individual distinguishing labels for each bar. [Source: Nuclear Regulatory Commission, 1996 - 1.2.4-2]

- **8.3.3.6.2 Bar spacing.** When data must be compared, bars should be adjacent to one another and spaced such that a direct visual comparison can be made without eye movement. [Source: Nuclear Regulatory Commission, 1996 - 1.2.4-3]

- **8.3.3.6.3 Consistent orientation of bars**. In a related series of bar charts, a consistent orientation of the bars (vertical or horizontal) should be adopted. [Source: Nuclear Regulatory Commission, 1996 - 1.2.4-4]

- **8.3.3.6.4 Highlighting.** When one bar represents data of a particular significance, then that bar should be highlighted. [Source: Nuclear Regulatory Commission, 1996 - 1.2.4-5]

- **8.3.3.6.5 Zero reference on deviation bar charts.** The zero reference should be the center of the deviation bar chart. [Source: Nuclear Regulatory Commission, 1996 - 1.2.4-6]

- **8.3.3.6.6 Normal range on deviation bar charts.** On a deviation bar chart, the range of normal conditions for positive or negative deviations should represent no more than 10% of the total range. [Source: Nuclear Regulatory Commission, 1996 - 1.2.4-7]

- **8.3.3.6.7 Indication of magnitude on deviation bar charts.** The magnitude of each variable should be displayed when a deviation bar display is used as a primary display format for safety condition parameters. [Source: Nuclear Regulatory Commission, 1996 - 1.2.4-8]

- **8.3.3.6.8 Coding segmented bar charts**. Segmented bars in which differently coded segments are shown cumulatively within a bar should be used when both the total measures and the portions represented by the segments are of interest. [Source: Nuclear Regulatory Commission, 1996 - 1.2.4-9]

- **8.3.3.6.9 Ordering data in segmented bars.** The data categories should be ordered within each bar in the same sequence, with the least variable categories displayed at the bottom and the most variable at the top. [Source: Nuclear Regulatory Commission, 1996 - 1.2.4-10]

8.3.3.7 Pie charts

- **8.3.3.7.1 When to use.** Pie charts should be used to show the proportional distribution of categories with respect to the sum of the categories. [Source: DOE HFDG ATCCS, V2.0, 9.6.1.1]

- **8.3.3.7.2 When not to use.** When accurate judgments of magnitudes are required, bar charts should be used rather than pie charts. [Source: DOE HFDG ATCCS, V2.0, 9.6.5]

- **8.3.3.7.3 Labeling pie chart segments.** Pie chart segments should be labeled inside the segments, if possible. [Source: DOE HFDG ATCCS, V2.0, 9.6.5.1]

- **8.3.3.7.4 Label orientation.** Segment labels should be oriented for normal left-to-right reading. [Source: DOE HFDG ATCCS, V2.0, 9.6.5.1]

- **8.3.3.7.5 Label content.** Segment labels should include a number stating either the percentage of the whole number represented by the segment or the absolute number the segment represents (or both). [Source: DOE HFDG ATCCS, V2.0, 9.6.5.1]

- **8.3.3.7.6 Highlighting segments.** Segments requiring emphasis should be highlighted or displaced slightly from the rest of the pie chart. [Source: DOE HFDG ATCCS, V2.0, 9.6.5.2]

8.3.3.8 Linear profile charts

- **8.3.3.8.1 Linear profile pattern recognition.** The graph should form recognizable geometric patterns for specific abnormal conditions. [Source: Nuclear Regulatory Commission, 1996 - 1.2.5-16]

- **8.3.3.8.2 Coding linear profile charts.** The area below the profile line should be shaded to provide a more distinguishable profile. [Source: Nuclear Regulatory Commission, 1996 - 1.2.5-17]

- **8.3.3.8.3 Labeling linear profile charts.** Labels should be provided along the bottom of linear profile charts to identify each parameter. [Source: Nuclear Regulatory Commission, 1996 - 1.2.5-18]

8.3.3.9 Circular profile chart

- **8.3.3.9.1 Circular profile chart recognition.** The circular profile chart should form a recognizable geometric pattern for specific abnormal conditions. [Source: Nuclear Regulatory Commission, 1996 - 1.2.5-19]

- **8.3.3.9.2 Labeling circular profile displays.** Labels should be provided to identify each radial line. [Source: Nuclear Regulatory Commission, 1996 - 1.2.5-20]

- **8.3.3.9.3 Coding circular profile displays.** The profile should be shaded to enhance the operator's perception of system status. [Source: Nuclear Regulatory Commission, 1996 - 1.2.5-21]

8.3.3.10 Segmented curve graphs

- **8.3.3.10.1 Depicting bands in segmented curve graphs.** All segments in a segmented curve graph should be related to the total value. [Source: Nuclear Regulatory Commission, 1996 - 1.2.5-22]

- **8.3.3.10.2 Ordering data in segmented curve graphs**. The data categories in a segmented curve graph should be ordered so that the least variable curves are displayed at the bottom and the most variable at the top. [Source: Nuclear Regulatory Commission, 1996 - 1.2.5-23]

- **8.3.3.10.3 Coding segmented curve graphs**. The different bands of segmented curve graphs should be labeled directly within the textured or shaded bands. [Source: Nuclear Regulatory Commission, 1996 - 1.2.5-24]

- **8.3.3.10.4 Labeling segmented curve graphs**. Where space permits, the different bands of segmented curve graphs should be labeled directly within the textured or shaded bands. [Source: Nuclear Regulatory Commission, 1996 - 1.2.5-25]

8.3.3.11 Flowcharts

Flowcharts. Flowcharts are appropriate for showing schematic representations of sequential processes and as aids to solving problems if solutions can be reached by answering a series of questions. [Source: DOE HFDG ATCCS, V2.0, 9.8.2]

- **8.3.3.11.1 Flowchart design.** Flowchart design should follow either

  a. logical or sequential order, or

  b. minimum path length. [Source: DOE HFDG ATCCS, V2.0, 9.8.2.1]

- **8.3.3.11.2 Flowchart symbol set.** There should be a standard set of flowchart symbols. [Source: Nuclear Regulatory Commission, 1996 - 1.2.7-6]

- **8.3.3.11.3 Consistency.** Words and phrases used for the same purpose shall be consistent throughout a flowchart, an application, and related applications. [Source: DOE HFDG ATCCS, V2.0, 9.8.2.7]

- **8.3.3.11.4 Highlighting.** Paths or portions of a flowchart that deserve particular attention should be highlighted. [Source: DOE HFDG ATCCS, V2.0, 9.8.2.5]

- **8.3.3.11.5 Flowcharts as decision aids.** Flowcharts used as decision aids should require only one decision at each step.

- **8.3.3.11.6 Logically ordered options.** Flowcharts used as decision aids should provide a logically ordered list of available options. [Source: DOE HFDG ATCCS, V2.0, 9.8.2.6]

- **8.3.3.11.7 Flowchart orientation.** When possible, flowcharts should be oriented so that paths conform

  a. left-to-right,

  b. top-to-bottom, or

  c. clockwise. [Source: DOE HFDG ATCCS, V2.0, 9.8.2.2]

8.3.3.12 Diagrams

Diagrams are appropriate if users require information about spatial relationships among objects but not the level of detail provided by pictures.

- **8.3.3.12.1 Large diagrams.** When a diagram is too large to view all at once, it should

  a. be presented in separate sections, with an overview that indicates the separate sections.

  b. have consistent notation throughout the diagram.

  c. provide an easy means for users to move among the sections. [Source: DOE HFDG ATCCS, V2.0, 9.8.1.1]

- **8.3.3.12.2 Level of detail.** Mimics and diagrams should contain the minimum amount of detail required to yield a meaningful pictorial representation. [Source: Nuclear Regulatory Commission, 1996 - 1.2.8-1]

- **8.3.3.12.3 Component identification.** System components represented on mimic lines should be identified. [Source: Nuclear Regulatory Commission, 1996 - 1.2.8-2]

- **8.3.3.12.4 Line points of origin.** All flow path origin points should be labeled or end at labeled components. [Source: Nuclear Regulatory Commission, 1996 - 1.2.8-3]

- **8.3.3.12.5 Line termination points.** All flow path line destination or terminal points should be labeled or end at labeled components. [Source: Nuclear Regulatory Commission, 1996 - 1.2.8-4]

- **8.3.3.12.6 Directional arrowheads.** Flow directions should be clearly indicated by distinctive arrowheads. [Source: Nuclear Regulatory Commission, 1996 - 1.2.8-5]

- **8.3.3.12.7 Line coding.** Flow lines should be coded (e.g., by color and/or width) to indicate important information. [Source: Nuclear Regulatory Commission, 1996 - 1.2.8-6]

- **8.3.3.12.8 Overlapping lines.** Overlapping of flow path lines should be avoided. [Source: Nuclear Regulatory Commission, 1996 - 1.2.8-7]

- **8.3.3.12.9 Symbol-data integration.** Where symbols are used to represent equipment components and process flow or signal paths, numerical data should be presented reflecting inputs and outputs associated with equipment. [Source: Nuclear Regulatory Commission, 1996 - 1.2.8-8]

- **8.3.3.12.10 Highlighting portions of diagrams.** When portions of a diagram require special attention, those portions should be highlighted. [Source: DOE HFDG ATCCS, V2.0, 9.8.1.2]

- **8.3.3.12.11 Rotation of diagrams.** When users may need to view a diagram from different perspectives, the application should provide the capability of rotating the diagram. [Source: DOE HFDG ATCCS, V2.0, 9.8.1.3]

- **8.3.3.12.12 Rotated diagram labels.** The labels of a rotated diagram should be displayed "right-side up" and be legible from the user's perspective. [Source: DOE HFDG ATCCS, V2.0, 9.8.1.3]

8.3.4 Graphics entry and manipulation

8.3.4.1 Graphics entry and editing

- **8.3.4.1.1 Drawing lines.** The system should draw lines between user specified points. [Source: MIL-HDBK-761A, 5.2.6.2.1.a]

- **8.3.4.1.2 Drawing figures.** The system should support the drawing of rectangles, circles, arcs, ovals, and other figures. [Source: MIL-HDBK-761A, 5.2.6.2.1.a]

- **8.3.4.1.3 Constraining lines.** Users should be able to constrain lines to be exactly vertical or horizontal. They should also be able to specify that a line is perpendicular or parallel to another line. [Source: MIL-HDBK-761A, 5.2.6.2.1.c]

- **8.3.4.1.4 Alignment grid.** The system should provide the capability of aligning objects on an invisible rule or grid structure at a user's request and at user specified grid intervals. [Source: MIL-HDBK-761A, 5.2.6.c, 5.2.6.2.a]

- **8.3.4.1.5 Alternate drawing methods.** When required by the task, alternate methods should be provided for drawing objects. For example, a circle might be drawn by specifying a center and a radius or diameter or by specifying the size and location of an enclosing square. [Source: MIL-HDBK-761A, 5.2.6.2.1 d]

- **8.3.4.1.6 Automatic figure completion.** Users should be able to select automatic figure completion, that is, automatic closure of polygons. [Source: MIL-HDBK-761A, 5.2.6.2.d,5.2.6.2.2.c]

- **8.3.4.1.7 Required line connection.** When separately drawn lines must connect at terminal points, the system should automatically make the connections. [Source: MIL-HDBK-761A, 5.2.6.2.d,5.2.6.2.2.c]

- **8.3.4.1.8 Displaying attributes.** When desired by the user, object attributes should be displayed as selected and not be represented as appended codes or by some other means. [Source: MIL-HDBK-761A, 5.2.6.3.b]

- **8.3.4.1.9 Colors and patterns.** Users should be able to fill enclosed areas with colors or patterns. [Source: MIL-HDBK-761A, 5.2.6.2.c]

- **8.3.4.1.10 Selectable elements and attributes.** Users should be able to select and edit display elements (e.g., lines) and their attributes (e.g., thickness) by pointing to and selecting from displayed examples. [Source: MIL-HDBK-761A, 5.2.6.3.a]

- **8.3.4.1.11 Manipulating objects.** Users should be able to copy, rotate, and reverse (produce mirror images) objects both horizontally and vertically. [Source: MIL-HDBK-761A, 5.2.6.2.1.e]

- **8.3.4.1.12 Editing objects.** User-selectable objects should be easily repositioned, duplicated, and deleted. [Source: MIL-HDBK-761A, 5.2.6.3.e]

- **8.3.4.1.13 Scaling objects.** Users should be able to enlarge and reduce the size of objects. [Source: MIL-HDBK-761A, 5.2.6.2.b]

- **8.3.4.1.14 Zoom capability.** A zoom capability should be provided to enlarge critical display areas. [Source: MIL-HDBK-761A, 5.2.6.2.f]

- **8.3.4.1.15 Overlapping objects.** When two objects overlap, if the user desires it, the system should obscure the overlapped portion of the less important object. [Source: MIL-HDBK-761A, 5.2.6.2.2.a]

- **8.3.4.1.16 Grouping objects.** The system should provide a means to group separate objects into a single grouped object that can then be treated as a single object. [Source: MIL-HDBK-761A, 5.2.6.2.2.b]

- **8.3.4.1.17 Suitability/appropriateness of drop shadows.** Drop shadows should be used to make important elements appear closer to the user. [Source: CTA, 1996 - 7.9.1)

- **8.3.4.1.18 Placement of shadows.** Shadows should be placed at the lower right of icons and buttons, as if light were coming from the upper left and along the bottom and right side of a pull-down menu, dialog box, or window to attract the users attention. [Source: CTA, 1996 - 7.9.1.1 & 7.9.1.2)

- **8.3.4.1.19 Beveled edges.** Beveled edges should be considered to bring important screen elements into the foreground. Beveled edges may be used on icons, buttons, menus, dialog boxes, and windows. [Source: CTA, 1996 - 7.9.2)

- **8.3.4.1.20 Enhancing three-dimensional effects.** Shading should be used at the bottom and right beveled edges to enhance the three-dimensional effect. [Source: CTA, 1996 - 7.9.2.1)

8.3.4.2 User aids

- **8.3.4.2.1 Entering data for plotting.** When complex graphic data must be entered quickly, computer aids should be provided.

  Example. When plotting data within Cartesian coordinates, the system automatically draws lines between the specified points of a function. [Source: MIL-HDBK-761A, 5.2.6.4.a]

- **8.3.4.2.2 Plotting stored data.** The system should support automatic plotting of stored data. [Source: MIL-HDBK-761A, 5.2.6.4.b]

- **8.3.4.2.3 Scaling graphic data.** The system should provide for automatic scaling of graphic data, and be able to modify system-generated scales. [Source: MIL-HDBK-761A, 5.2.6.4.d]

8.3.4.3 Creating and editing

Computer aids such as those listed in this section need to be provided for the entry and organization of complex graphic data. [Source: DOE HFDG ATCCS, V2.0, 9.2.1]

- **8.3.4.3.1 Validation.** The application software should validate data entered. [Source: DOE HFDG ATCCS, V2.0, 9.2.2]

  Discussion. Validation might include comparison with a range or set of values with other entries. [Source: DOE HFDG ATCCS, V2.0, 9.2.2]

- **8.3.4.3.2 Plotting aids.** When plotting formats are known, templates or other data entry aids should be provided. [Source: DOE HFDG ATCCS, V2.0, 9.2.3]

- **8.3.4.3.3 Plotting stored data.** The application should provide automated or aided plotting and editing of stored data. [Source: DOE HFDG ATCCS, V2.0, 9.2.4]

- **8.3.4.3.4 Minimize clutter.** Old data points should be removed after some fixed period of time. [Source: Nuclear Regulatory Commission, 1996 - 1.2.5-11]

- **8.3.4.3.5 Automated production of scales.** The application should automatically adjust the range of scales or provide the user with automated aids for scaling graphic data. [Source: DOE HFDG ATCCS, V2.0, 9.2.5]

- **8.3.4.3.6 Line drawing.** The application should provide users with automated aids for drawing straight and curvilinear lines. [Source: DOE HFDG ATCCS, V2.0, 9.2.6.1]

- **8.3.4.3.7 Automatic completion of polygons.** The application should provide automatic completion to users drawing polygons, providing a line that connects the current cursor position to its starting point and giving the user the option to make the provided line a permanent part of the figure. [Source: DOE HFDG ATCCS, V2.0, 9.2.6.2]

- **8.3.4.3.8 Joining lines.** The application should provide automated assistance in joining lines. [Source: DOE HFDG ATCCS, V2.0, 9.2.6.3]

- **8.3.4.3.9 Designating line segments.** Users should be able to identify and select line segments for moving and editing. [Source: DOE HFDG ATCCS, V2.0, 9.2.6.4]

- **8.3.4.3.10 Grid references.** The application should provide optional, adjustable grid references to aid users in aligning horizontal and vertical lines. [Source: DOE HFDG ATCCS, V2.0, 9.2.6.5]

- **8.3.4.3.11 User-specified rules.** Users should be able to specify rules for attributes, relationships, and design and have the computer apply those rules automatically during the design process. For example, a user might specify that hand-drawn lines be straightened or that the angles between intersecting lines be adjusted. [Source: DOE HFDG ATCCS, V2.0, 9.2.7]

- **8.3.4.3.12 Computer aids.** The application should provide prompts and computer-aided methods for drawing figures. [Source: DOE HFDG ATCCS, V2.0, 9.2.8]

- **8.3.4.3.13 Scale changes.** The application should allow users to edit or create drawings in a large scale and then reduce them to the desired scale. [Source: DOE HFDG ATCCS, V2.0, 9.2.9]

- **8.3.4.3.14 Basic operations.** The application should allow users to resize, copy, move, rotate, and produce mirror images of objects. [Source: DOE HFDG ATCCS, V2.0, 9.2.10, 9.2.11]

- **8.3.4.3.15 Grouping elements.** The application should allow users to select and group elements that can then be treated as a single object. [Source: DOE HFDG ATCCS, V2.0, 9.2.12]

- **8.3.4.3.16 Area fill capability.** The application should allow users to fill enclosed areas with selected attributes such as color or patterns. [Source: DOE HFDG ATCCS, V2.0, 9.2.13]

- **8.3.4.3.17 Automated aids.** When users must perform detailed analyses of images, the application should provide automated aids (e.g., the capability to zoom in on a portion of the picture). [Source: DOE HFDG ATCCS, V2.0, 9.7.2]

8.3.4.4 Panning and zooming

- **8.3.4.4.1 When to provide scrolling, paging, and panning.** When information to be displayed exceeds the available display area, the system should provide a scrolling, paging, or panning capability. [Source: MIL-HDBK-761A, 5.3.2.2.2.a]

- **8.3.4.4.2 When to provide zooming.** When a user will need to view objects such as pictures, diagrams, or maps in detail, the system should provide a zooming capability. [Source: MIL-HDBK-761A, 5.3.2.2.2.b]

  Discussion. When zooming has expanded a portion of a display, it is also desirable to display the portion in its original size and as much of its surrounding context as will fit. Alternatively, the original display might be reduced and displayed with the enlarged portion highlighted. [Source: MIL-HDBK-761A, 5.3.2.2.2.b]

- **8.3.4.4.3 Scale indication.** When zooming has expanded a portion of a display, the system should provide a scale indicating the amount of expansion. [Source: MIL-HDBK-761A, 5.3.2.2.2.c]

- **8.3.4.4.4 Scale integration.** Panning and zooming functions should be integrated with and include scales and other overlaid data such as scale marks and range vectors. [Source: MIL-HDBK-761A, 5.3.2.2.2.d]

8.4 Concealed information

8.4.1 Information suppression

- **8.4.1.1 Suppression indication.** When the display of information is temporarily suppressed, an indication of this suppression shall be provided on the display. [Source: MIL-HDBK-761A, 5.3.2.2.3.a]

- **8.4.1.2 Indication of changes in suppressed information.** The user should be notified of any significant changes in suppressed information, restoring suppressed data quickly to the originally displayed form. [Source: MIL-HDBK-761A, 5.3.2.2.3.b]

- **8.4.1.3 Restoration of suppressed information.** The system shall provide a quick and easy means for restoring suppressed information. [Source: MIL-HDBK-761A, 5.3.2.2.3.c]

- **8.4.1.4 Suppression.** The user should be permitted to suppress displayed data not required for the task at hand. [Source CTA, 1996 - 6.1.4]

8.5 Dynamic information update

8.5.1 General

- **8.5.1.1 Rate of change or gross values.** When users must identify the rate of change or read only gross values, the rate of update should be from two to five times a second. [Source: DON UISNCCS, V1.2, 8.5.6]

- **8.5.1.2 Update rate.** When a task requires that a user read changing data, individual data items shall be displayed long enough for the user to read them reliably and accurately. [Source: MIL-HDBK-761A, 5.3.2.4.a]

  Example. An Air Traffic Control Specialist may be required to read the speed or bearing of an aircraft as it changes. [Source: MIL-HDBK-761A, 5.3.2.4.a]

- **8.5.1.3 Alphanumeric data.** Alphanumeric data that users are required to read reliably and accurately shall not be updated more often than once a second. [Source: MIL-HDBK-761A, 5.3.2.4.c]

- **8.5.1.4 User control of automatic updating.** Users should be able to select the categories of information that will be updated automatically and to specify the frequency and rate at which the information will be updated (within the range capable of being met by the information source and the processing equipment). [Source: DON UISNCCS, V1.2, 8.5.6]

- **8.5.1.5 User stop of update.** When appropriate, the application should provide users the ability to temporarily stop and then resume updating automatically changing information. [Source: DON UISNCCS, V1.2, 8.5.6]

- **8.5.1.6 Initial erasure to replace changed data.** When the computer generates a display to update changed data, the old items should be erased before adding new data items to the display. [Source: Nuclear Regulatory Commission, 1996 - 1.4-4]

- **8.5.1.7 Dynamic information in frozen, inactive, and minimized windows.** Applications should notify users of critical information that becomes available in frozen, inactive, and minimized windows such as data changes that result from automatic updating of a display. [Source: CTA, 1996 - 6.1.3.1 and 6.1.3.2; DON UISNCCS, V1.2, 8.5.5, 8.5.6]

- **8.5.1.8 Predictions and trends based on changing data.** Integrated trend displays and predictive displays should be provided if the user must determine trends over time or make predictions based on changing data. [Source: CTA 6.1.3.3]

8.6 Color

Color can be helpful in differentiating classes of information in complex, dense, and critical displays. Users often express a preference for color, even when it does not improve their performance. Although it may improve motivation and memory, performance advantages associated with the use of color tend to be highly task dependent. For example, color is helpful in class-coding tasks. Its high conspicuity value means that less time is wasted in checking targets that are not in the required class.

8.6.1 General

- **8.6.1.1 When to use color.** Color should be used

  a. to augment a user's understanding of the information being presented,

  b. to attach specific meaning to a portion of text or a symbol,

  c. to direct a user's attention to something (highlighting critical elements),

  d. to reduce clutter,

  e. to identify and classify information,

  f. to indicate changes in status,

  g. as a formatting aid, and

  h. to enhance legibility. [Source: DOD HCISG V2.0, 4.3, 4.3.1.1; National Air Traffic Services, 1999 – 1.11.2.1]

- **8.6.1.2 Conservative use.** Color shall be used conservatively as an information discriminator especially when the color deficiency in the user population is unknown. [Source: DOD HCISG V2.0, 4.3, MIL-HDBK-761A, 5.3.1.6.4.f]

- **8.6.1.3 Consistency.** Colors shall be used consistently within a screen, within an application, and across a set of applications. [Source: DON UISNCCS, V1.2, 8.3.2]

- **8.6.1.4 Data categories.** When color is used to identify data categories, its use shall not conflict with other color-coding conventions. [Source: MIL-HDBK-761A, 5.3.1.6.4.c]

- **8.6.1.5 Redundant use.** Color-coding should not be used alone; it should be redundant to some other means of coding, such as shape, size or texture. [Source: MIL-HDBK-761A, 5.3.1.6.4.d]

- **8.6.1.6 Use of color.** Colors shall be easily discriminable, with each color representing only one category of displayed data. [Source: DOD HCISG V2.0, 4.3.1.2]

- **8.6.1.7 Readability.** The use of color should not reduce screen readability. [Source: DOD HCISG V2.0, 4.3.2.1.a, 4.3.2.1.b: DOD HCISG V2.0, 4.3.2.1.c]

- **8.6.1.8 Adding color.** Color should only be added after the effectiveness of a screen has been maximized in an achromatic format. [Source: DOD HCISG V2.0, 4.3.1.2]

- **8.6.1.9 Small areas.** Users shall not have to discriminate among colors in small areas. [Source: DOD HCISG V2.0, 4.3.1.2.h]

- **8.6.1.10 Coding small areas.** When small areas of the display must be coded, they shall be coded achromatically. [Source: DOD HCISG V2.0, 4.3.1.2.h]

- **8.6.1.11 Color legends**. Color should not be used to substitute for written legends. [Source: National Air Traffic Services, 1999 - 1.11.2.3]

- **8.6.1.12 Unknown target.** Color should not be used if multiple other items in the display are or might be the same color as the target. [Source: National Air Traffic Services, 1999 - 1.11.2.1]

  Discussion. Color can improve performance in visual search tasks when the color of the target is known. However, if the color of the target is not known, color can act as a distracter and degrade performance. This effect is more pronounced with increasing display density. [Source: National Air Traffic Services, 1999 - 1.11.2.1]

8.6.2 Color selection

- **8.6.2.1 Drawing attention.** Brighter or more saturated colors should be used to draw a user's attention to critical data. [Source: MIL-HDBK-761A, 5.3.1.6.4.g]

  Discussion: Highly saturated colors may lead to unwanted effects such as afterimages; particularly undesirable effects (e.g., binocular rivalry) can arise from highly saturated reds located near highly saturated blues.

- **8.6.2.2 Color brightness.** When color is used to emphasize information, the brightest color should be used for the most important information. [Source: DOD HCISG V2.0, 4.3.1.2]

- **8.6.2.3 Tonal coding.** Tonal coding should be used to show relative values of a single variable. [Source: DOD HCISG V2.0, 4.3.3.1]

  Definition. Tonal coding is coding based on different shades of the same hue or different patterns or textures.

- **8.6.2.4 Ordered coding.** When tonal coding is used to display relative values of a variable, the lightest shade should correspond to the smallest value, and the darkest shade to the highest value. [Source: DOD HCISG V2.0, 4.3.3.2]

- **8.6.2.5 Use of hues.** When similar hues are used, they should be used only with logically related information. [Source: DOD HCISG V2.0, 4.3.1.2]

- **8.6.2.6 Colors for infrequently used information.** Shorter wavelength colors (e.g., blue and green) should be used to display information that is used infrequently, such as status or background information. [Source: DOD HCISG V2.0, 4.3.2.1.c]

- **8.6.2.7 Blue.** Blue should not be used as the foreground color if resolution of fine details is required. Blue is acceptable as a background color. [Source: DOD HCISG V2.0, 4.3.2.4.d, 4.3.2.7]

- **8.6.2.8 Color and ambient illumination.** Red should be used only if high ambient illumination is expected and green and yellow if a broad range of illumination is expected. [Source: DOD HCISG V2.0, 4.3.2.5]

- **8.6.2.9 Green, yellow, and red.** When green, yellow, and red are used, they shall be used in combination with other cues, such as brightness and saturation, to enhance their distinctiveness. [Source: DOD HCISG V2.0, 4.3.1.2.f]

8.6.3 Location

- **8.6.3.1 Peripheral vision.** Peripheral vision is very poor at discriminating colors; therefore, the use of color should be reserved for portions of visual displays that will normally be in the user's direct line of sight. [Source: National Air Traffic Services, 1999 - 1.11.2.9.2.12.1.2.1]

  Discussion. Only large colored objects will be distinguished in the peripheral visual field. [Source: National Air Traffic Services, 1999 - 1.11.2.9.2.12.1.2.1]

- **8.6.3.2 Colors in the periphery.** Red and green should not be used to code items in peripheral vision (e.g., at the periphery of large screen displays) while blue, yellow, black, or white should be used for color-coded items located in the peripheral viewing area. [Source: DOD HCISG V2.0, 4.3.2.9]

8.6.4 Meaning

- **8.6.4.1 One meaning per color.** Each color should represent only one category of displayed data. [Source: DOD HCISG V2.0, 4.3.2.1.c]

- **8.6.4.2 Retain meaning of colors.** When the user community has previously established meanings for various colors, the designer shall retain those meanings. Thus, a color should not signify a different condition than it signified in the previous system. [Source: CTA, 1996 - 7.1.6 and 7.1.6.1]

  Discussion. Many FAA domains have set conventions regarding color use that need to be considered before applying color-coding.

- **8.6.4.3 Reserved meanings.** Color coding shall conform to the following reserved meanings consistent with conventional associations for particular colors:

  a. Red shall indicate conditions such as no-go, error, failure, or malfunction.

  b. Flashing red shall be used only to indicate emergency conditions requiring immediate user action to avert personnel injury or equipment damage.

  c. Yellow shall indicate marginal conditions, alert users to situations where caution or rechecking is necessary, or notify users of an unexpected delay.

  d. Green shall indicate that a monitored process or unit of equipment is within tolerance, that a condition is satisfactory, or that it is all right to proceed with an operation or transaction.

  e. White shall indicate alternative functions or system conditions that do not have operability or safety implications.

  f. Blue shall be used only as an advisory color. [Source: MIL-HDBK-761A, 5.3.1.6.4.b]

  Discussion. The use of colors to indicate conventional meanings is also dependent on the color appearing against an appropriately contrasting background. For instance, white or light gray is appropriate for black text. [Source: MIL-HDBK-761A, 5.3.1.6.4.b]

- **8.6.4.4 Colors for action and status.** Longer wavelength colors (e.g., red and orange) should be used to suggest action or a demand for a response. [Source: DOD HCISG V2.0, 4.3.2.1.d]

8.6.5 Color relative to adjacent colors

- **8.6.5.1 Relative color.** The color of other figures and the background relative to a particular item should be considered in order to provide the appropriate color contrast and emphasis to the color-coding of a particular item. [Source: MIL-HDBK-761A, 5.3.1.6.4.a]

- **8.6.5.2 Color pairs to avoid.** Designers should avoid the color combinations listed in Exhibit 8.6.5.2.

Exhibit 8.6.5.2 Color combinations to avoid.

Saturated Red and Blue	Saturated Red and Green
Saturated Blue and Green	Saturated Yellow and Green
Yellow on Purple	Green on White
Yellow on Green	Blue on Black
Magenta on Green	Red on Black
Magenta on Black	Yellow on White

[Source: CTA, 1996 - 7.1.2 and Table 7-2]

- **8.6.5.3 Test colors.** Selected colors should be tested with users to verify that the colors can be easily discriminated from each other. [Source: CTA, 1996 - 7.1.3.4]

- **8.6.5.4 Colors for comparison.** Green, yellow, and red should be avoided as comparison colors for application information requiring important or frequent discriminations. [Source: DOD HCISG V2.0, 4.3.1.2.c]

- **8.6.5.5 Adjacent colors.** Highly saturated colors with significantly different wavelengths (those toward opposite ends of the spectrum) should not be used next to each other. [Source: DOD HCISG V2.0, 4.3.2.4]

  Definition. Saturation is the relative amount of whiteness in a chromatic color. [Source: DOD HCISG V2.0, 4.3.2.4]

- **8.6.5.6 Conveying similarity.** Similar colors should be used to convey similarity among items; examples are orange/yellow and blue/violet. [Source: DOD HCISG V2.0, 4.3.2.4]

- **8.6.5.7 Discrimination of colors.** The colors selected for coding on a screen shall be easily discriminated from one another in all expected operating conditions. [Source: DOD HCISG V2.0, 4.3.2.1.a, 4.3.2.1.b]

- **8.6.5.8 Varying lightness.** Color combinations that are similar in lightness shall be avoided (e.g., navy blue on black, yellow on white). [Source: CTA, 1996 - 7.1.3.1.1]

  Discussion. Consider the effects of varying levels of saturation (color intensity) and the effects of varying levels of lightness (amount of white mixed with color) on the ability to discriminate colors and on color interactions. [Source: CTA, 1996 - 7.1.3.1.1]

- **8.6.5.9 Number of levels on colored displays**. Due to the relationship between brightness and color, a maximum of two luminance levels should be used for coding on colored displays. [Source: National Air Traffic Services, 1999 – 1.11.10.3].

8.6.6 Foreground/background

- **8.6.6.1 Foreground and background contrast.** The foreground color should contrast highly with the background color. [Source: DOD HCISG V2.0, 4.3.2.4]

  Definition. Contrast is the difference in luminance of two areas. Contrast is often represented in terms of a **contrast ratio,** expressed as the ratio of foreground to background luminance (e.g., 7:1). [Source: DOD HCISG V2.0, 4.3.2.4]

- **8.6.6.2 Text-background contrast.** The contrast between text and its background shall be sufficiently high to ensure readability of the text. [Source: DOD HCISG V2.0, 4.2.3.5.f, 4.3.1.2.j]

- **8.6.6.3 Color foreground/background difference.** In general, the color foreground shall differ from its background by a minimum of 100 $_{\Delta}$E (CIE Yu' v') distances. [Source: DOD HCISG V2.0, 4.2.3.5.f, 4.3.1.2.j]

- **8.6.6.4 Contrast.** An adequate contrast of at least 7:1 should be maintained between foreground and background colors to enhance color perception and perceived image resolution. [Source: CTA, 1996 - 7.1.3.2, 7.1.3.4]

  Discussion. To maximize color contrast, consider using complementary colors (yellow on dark blue, magenta on green) if appropriate for the user's task environment. [Source: CTA, 1996 - 7.1.3.2.2]

- **8.6.6.5 Contrast in dim lighting.** The contrast should be increased if the screen will be viewed under dim lighting conditions. [Source: CTA, 1996 - 7.1.3.2.1]

- **8.6.6.6 Achromatic background.** A medium achromatic background (e.g., dark or medium gray) should be used to maximize the visibility of foreground colors. [Source: CTA, 1996 - 7.1.3]

8.6.7 Number of colors

- **8.6.7.1 Number of colors to use.** Color should be introduced into screens conservatively, using relatively few colors to designate critical categories of displayed data and only if it will facilitate user understanding or performance**.** [Source: DOD HCISG V2.0, 4.3.2.3.a]

- **8.6.7.2 Task requirements.** Task performance requirements shall be used as the basis for determining the number of colors presented together on the same screen. [Source: CTA, 1996 - 7.1.1.1]

- **8.6.7.3 Maximum number of colors.** The total number of colors used should not exceed four for a single alphanumeric screen and seven for a set of related screens. [Source: DOD HCISG V2.0, 4.3.2.3.b]

- **8.6.7.4 Additional colors.** Additional colors (more than four) should be reserved for special use (e.g., in map displays). [Source: DOD HCISG V2.0, 4.3.2.3.c]

  Discussion. Only eight or nine highly saturated colors can be easily discriminated. [Source: DOD HCISG V2.0, 4.3.2.3.c]

- **8.6.7.5 Recommended number of colors.** Designers should limit the number of colors to be used.

  a. No more than six distinct colors or shades of gray should be used if the user must recall the meanings of colors or shades.

  b. No more than six distinct colors should be used if the user must perform rapid visual searching based on color discrimination. [Source: CTA, 1996 - 7.1.1.2, and 7.1.1.3]

8.6.8 Keys/legends

- **8.6.8.1 Color key.** When the use of color is extensive or unusual (e.g., if functional requirements dictate the use of more than the recommended number of colors or shades of gray) or when a display may be used infrequently, the display should include a color key or legend that explains the color/shade meanings. [Source: DOD HCISG V2.0, 4.3.2.8]

- **8.6.8.2 Key accessibility.** When used, a color key should be readily accessible that is visible without the user having to scroll or expand the display. [Source: DOD HCISG V2.0, 4.3.2.8]

- **8.6.8.3 Colors in key.** A color key should include the actual colors being defined. [Source: DOD HCISG V2.0, 4.3.2.8]

8.6.9 User preferred color sets

- **8.6.9.1 User preferences.** When appropriate to the functionality of an application, users should have the option of selecting from a variety of color sets as a user preference setting for aspects of an application that do not involve coding or status. [Source: DON UISNCCS, V1.2, 8.3.1]

- **8.6.9.2 Easy return to default color scheme.** When users are allowed to change color settings of aspects of an application that do not involve coding, the application shall provide an easy way to restore the default color scheme. [Source: DOD HCISG V2.0, 4.3]

- **8.6.9.3 Portable applications.** When an application is likely to be used on different hardware configurations, it shall be able to accommodate the possible differences in color representations in the different configurations. [Source: DOD HCISG V2.0, 4.3]

- **8.6.9.4 Status colors.** Status colors shall be assigned during installation, and users shall not be allowed to change them. [Source: DOD HCISG V2.0, 4.3]

- **8.6.9.4 Coding and status colors.** When different users will share a computer monitor, individual users shall not be able to change colors for coding and status of facilities, services, or equipment such as alarms or alerts. [Source: DON UISNCCS, V1.2, 8.3.1]

8.6.10 Color-coded symbols

- **8.6.10.1 Code symbol, not text.** When color is used to indicate status changes, a box or other shape adjacent to the text shall change color instead of the text itself. [Source: DOD HCISG V2.0, 4.3.1.2.i]

8.7 Coding

This section contains guidelines on coding not covered in other sections. Information on text coding, color coding, auditory coding, and coding in menus is contained in Section 8.2.5 on text displays, Section 8.6 on color displays, Section 8.16.1 on auditory displays and Section 8.8.5 on menus.

8.7.1 General

- **8.7.1.1 When to use.** When coding is used, it should differentiate items of information call a user's attention to important information, unusual situations, or potential problems that require user action; or indicate changes in the state of a system. [Source: MIL-HDBK-761A, 5.3.1.6.a]

- **8.7.1.2 Visual coding of critical information.** A user's attention should be drawn to critical information by highlighting, inverse video, color-coding, or other means. [Source: DON UISNCCS, V1.2, 8.5.5]

- **8.7.1.3 Coding data categories.** Categories of data should be coded if a user must distinguish the data included in the categories rapidly and if the data items are distributed in an irregular way on the display. [Source: MIL-HDBK-761A, 5.3.1.6.b]

- **8.7.1.4 Misuse of coding.** Visual coding shall be used for functional not decorative purposes. [Source: National Air Traffic Services, 1999 - 1.11.1.2]

- **8.7.1.5 Meaningful codes.** When codes are used, they should be meaningful rather than arbitrary. [Source: MIL-HDBK-761A, 5.3.1.6.c]

  Example. Male and female might be coded **M** and **F** rather than 1 and 2. [Source: MIL-HDBK-761A, 5.3.1.6.c]

- **8.7.1.6 Consistent coding.** Coding shall be consistent throughout an application and related applications. [Source: MIL-HDBK-761A, 5.3.1.6.d]

- **8.7.1.7 Special codes.** Codes that are assigned a special meaning in a display should be defined at the bottom of the display. [Source: MIL-HDBK-761A, 5.3.1.6.d]

- **8.7.1.8 Attention-getting techniques.** Coding techniques that have strong attention-getting qualities (e.g., color and flashing) should be used sparingly and judiciously. [Source: National Air Traffic Services, 1999 - 1.11.4.2.5]

8.7.2 Brightness/intensity coding

- **8.7.2.1 Consistent meaning.** Brightness coding shall have a single meaning throughout an application and related applications. [Source: MIL-HDBK-761A, 5.3.1.6.3.a]

- **8.7.2.2 Number of levels.** The number of brightness intensity levels used as codes shall not exceed three. [Source: MIL-HDBK-761A, 5.3.1.6.3.a]

  Discussion. Two levels of brightness intensity may be optimal because of possible difficulty in discriminating brightness levels. Three levels of brightness is the **maximum** when tasks need such discriminations. [Source: Ameritech Services Inc., 1996 - Table 5-1; MIL-HDBK-761A, 5.3.1.6.3.a]

- **8.7.2.3 Brightness ratios.** Each level of brightness shall be separated from an adjacent level by a 2:1 ratio. [Source: MIL-HDBK-761A, 5.3.1.6.3.b]

- **8.7.2.4 High brightness.** High brightness should be used to call attention to errors in data-entry fields and to highlight answer fields on question and answer screens. [Source: CTA, 1996 - 7.2.1.1]

- **8.7.2.5 More than one brightness level.** When two brightness levels are used to code information, the higher brightness should apply to the more critical information, and the lower brightness to the less critical information. [Source: National Air Traffic Services, 1999 - 1.11.10.3]

- **8.7.2.6 Highlighting during operations.** When a user is performing an operation on a selected object in a display, that object shall be highlighted. [Source: DOE HFDG ATCCS, V2.0, 2.2.6; MIL-HDBK-761A, 5.1.1.5.g]

  Discussion. In many applications, at least two different methods of selection highlighting can be provided. The first of these highlighting methods occurs when the pointer comes to rest for a predetermined time on a selected object. This is sometimes referred to as *dwell emphasis,* and it tells the user which object the computer perceives the user is about to select. This highlighting is normally dim white. The second type of highlighting occurs when an actual selection has been made and is normally a bright white. [Source: DOE HFDG ATCCS, V2.0, 2.2.6; MIL-HDBK-761A, 5.1.1.5.g]

- **8.7.2.7 Highlighting on dark backgrounds.** When the background is dark, white highlighting shall be used with dark letters to draw attention to particular data or portions of the screen. [Source: DOD HCISG V2.0, 4.3.1.2.i]

- **8.7.2.8 Highlighting on light backgrounds.** When the background is light, dark highlighting shall be used with white letters to draw attention to particular data or portions of the screen. [Source: DOD HCISG V2.0, 4.3.1.2.i]

- **8.7.2.9 Size and number of areas highlighted.** The size and number of areas highlighted shall be minimized. [Source: DOD HCISG V2.0, 4.3.1.2.i]

- **8.7.2.10 Reverse video.** Reverse video (e.g., brightness inversion) should be used to highlight critical items requiring user attention and return to a normal brightness when the user has responded. [Source: CTA, 1996 - 7.2.1.3 and 7.2.1.3.1]

  Discussion. Whereas it does have good attention- getting capability, reverse video should be used in moderation because it can reduce legibility. [Source: Ameritech Services Inc., 1998 - Table 4-1]

8.7.3 Flash coding

- **8.7.3.1 When to use.** Flash or blink coding should only be used to indicate an urgent need for the user's attention and response or to indicate the active location for data entry. [Source: CTA, 1996 - 7.3.1; MIL-HDBK-761A, 5.3.1.6.5.a]

  Discussion. Placing a blinking cursor at the point where user input will be accepted is a common use of flash coding. Overuse of flash or blink coding has a high potential to distract the user. [Source: CTA, 1996 - 7.3.1; MIL-HDBK-761A, 5.3.1.6.5.a]

- **8.7.3.2 Small area.** Only a small area of the screen should flash at any time. [Source: Nuclear Regulatory Commission, 1996 - 1.3.10-11]

- **8.7.3.3 Flashing rate.** The rate of flashing shall be in the range of three to five flashes per second with equal on and off durations. [Source: MIL-HDBK-761A, 5.3.1.6.5.b]

- **8.7.3.4 Multiple flash rates**. When two flash rates are used, the higher rate should apply to the more critical information, and the lower rate should be less than two flashes per second. [Source: MIL-HDBK-761A, 5.3.1.6.5.b; Nuclear Regulatory Commission, 1996 - 1.3.10-15]

- **8.7.3.5 Flash acknowledgement.** When flash coding is used, users should have a means of acknowledging the flashing which, when appropriate, automatically stops the flashing. [Source: MIL-HDBK-761A, 5.3.1.6.5.d]

- **8.7.3.6 When not to use.** Data or text that the user must read should never blink or flash because a blinking object is, by definition, not displayed continuously and can be read only when it is displayed. [Source: CTA, 1996 - 7.3]

- **8.7.3.7 Displayed objects.** When a displayed object is to be flash coded, a flashing symbol adjacent to the object should be used rather than flashing of the object itself. [Source: MIL-HDBK-761A, 5.3.1.6.5.c]

- **8.7.3.8 Flash coding for text.** When a user must read a displayed item that is flash coded, an extra symbol should be used to mark the item such as an asterisk or arrow, which flashes rather than having the item itself flash. [Source: Nuclear Regulatory Commission, 1996 - 1.3.10-10]

- **8.7.3.9 Flashing text.** When flash coding must be used on text, the flash rate should be 1/3 Hz to 1Hz with an on/off cycle of 70%. [Source: National Air Traffic Services, 1999 - 1.11.8.3]

8.7.4 Line coding

Lines can be used to aid in focusing the user's attention on related information or to separate unrelated groupings of information. Line borders delineate the boundaries of menu bars, display-control options, and entire windows. Lines can be coded by such attributes as width or thickness, color, and pattern (e.g., solid, dashed, and dotted).

- **8.7.4.1 Consistency.** Line codes should be used consistently to symbolize corresponding data. [Source: Smith & Mosier, 1986 - 2.4.3.7].

- **8.7.4.2 Length.** Line-length coding should be used for spatial categorizations in a single dimension, such as velocity or distance. [Source: CTA, 1996 - 7.4.1.2; MIL-HDBK-761A, 5.3.1.6.6.c]

  Discussion. The designer should be aware that long lines might add clutter to a display. [Source: CTA, 1996 - 7.4.1.2]

- **8.7.4.3 Direction.** Spatial categorization in two dimensions, for example, an aircraft altitude or bearing, should be coded by line direction. [Source: MIL-HDBK-761A, 5.3.1.6.6.d]

- **8.7.4.4 Graphic lines.** Graphic lines should contain a minimum of 50 resolution elements per inch which will give the user a sense of continuity. [Source: National Air Traffic Services, 1999 - 1.11.15.6]

- **8.7.4.5 Line orientation.** When the orientation of a line is used to code direction or value, contextual information should also be provided. [Source: National Air Traffic Services, 1999 - 1.11.15.7]

- **8.7.4.6 Line angle.** The maximum number of codes for line-angle coding should be 11. [Source: National Air Traffic Services, 1999 - 1.11.15.8]

- **8.7.4.7 Line width.** The maximum number of widths for line-width coding should be three. [Source: National Air Traffic Services, 1999 - 1.11.15.8]

- **8.7.4.8 Line type.** Line coding by type (e.g., solid, dashed, dotted), by width, or by other attributes should be used to indicate association between elements. [Source: CTA, 1996 - 7.4.1.1]

- **8.7.4.9 Use.** Line coding should be used sparingly. [Source: CTA, 1996 - 7.4]

8.7.5 Symbol coding

- **8.7.5.1 Design of symbols.** To the extent possible, a symbol should be an analog of the object it represents in general use and well known to the users or based on established standards or conventional meanings. [Source: MIL-HDBK-761A, 5.3.1.6.8.b]

- **8.7.5.2 Special symbols.** When special symbols such as asterisks or arrows are used, they shall be used consistently and with unique meanings throughout an application and related applications. [Source: MIL-HDBK-761A, 5.3.1.6.8.d, 5.3.1.6.8.e]

- **8.7.5.3 Special symbols and alphanumeric displays.** When used to draw attention to a selected item in alphanumeric displays, the symbol should be separated from the beginning of the word by a space. [Source: Nuclear Regulatory Commission, 1996 - 1.2.1-22]

8.7.6 Shape coding

- **8.7.6.1 Use.** The designer should use shape categories (e.g., circles, triangles, and squares) to code related objects and to support the user's ability to discriminate between various categories of displayed data. [Source: CTA, 1996 - 7.7]

- **8.7.6.2 Number of shape codes.** Where geometric shape coding is used and each shape is required to be identified without reference to any other, the number of shapes in the set should ideally be 5 and not normally exceed 15. [Source: MIL-HDBK-761A, 5.3.1.6.8.f]

  Discussion. The number of shapes used is dependant upon how often they are seen.

- **8.7.6.3 Resolution.** The designer should ensure that screen resolution is adequate for shape coding. [Source: National Air Traffic Services, 1999 - 1.11.5.1].

  Discussion. Good resolution is essential in guaranteeing that shapes are not mistaken for other shapes, such as confusing a hexagon for a circle. [Source: National Air Traffic Services, 1999 - 1.11.5.1].

- **8.7.6.4 Shapes to use.** Shapes used for shape coding should be based on established standards. [Source: National Air Traffic Services, 1999 - 1.11.5.1]

8.7.7 Size coding

- **8.7.7.1 Use.** Size coding should only be used when there is a low density of items on the display. [Source: National Air Traffic Services, 1999 - 1.11.6.1]

- **8.7.7.2 Number of sizes.** The number of different sizes used as codes shall not exceed three. [Source: MIL-HDBK-761A, 5.3.1.6.9]

  Discussion. Limiting size coding to only two to three sizes is preferable. Search time is longer for items coded by size than items coded by shape or color. [Source: National Air Traffic Services, 1999 - 1.11.6.2]

- **8.7.7.3 Size coding vs. font style coding.** Within a text file or table, the use of a different font style should be preferred over the use of a different size for highlighting information. [Source: Nuclear Regulatory Commission, 1996 - 1.2.1-21]

- **8.7.7.4 Larger sized object.** A larger sized object used for coding should be 1.5 times the height of the next smaller object (e.g., characters, symbols, and shapes) if it needs to be identified based on size. [Source: CTA, 1996 - 7.6.1]

8.7.8 Texture coding

- **8.7.8.1 Use.** Texture coding should be used redundantly with another form of coding (e.g., color). [Source: National Air Traffic Services, 1999 - 1.11.13.1]

- **8.7.8.2 Hatching.** Simple hatching should be used instead of elaborate patterns. [Source: National Air Traffic Services, 1999 - 1.11.13.2]

- **8.7.8.3 Distracting effects.** Texture coding should be tested by users to avoid potentially distracting visual effects. [Source: National Air Traffic Services, 1999 - 1.11.13.2]

8.7.9 Spatial coding

- **8.7.9.1 Use.** Spatial coding should be used to give meaning to an item of information such as to identify it as a menu item, or to indicate title pages, information fields, alarms, and active and static display areas. [Source: Nuclear Regulatory Commission, 1996 - 4.5.6.2-7]

- **8.7.9.2 Consistency.** Spatial coding should be used consistently throughout the system. [Source: Nuclear Regulatory Commission, 1996 - 4.5.6.2-7]

- **8.7.9.3 Importance.** Spatial coding should be used to indicate alarm importance. [Source: Nuclear Regulatory Commission, 1996 - 4.5.6.2-7]

- **8.7.9.4 Grouping.** White space should be used with group-related items. [Source: National Air Traffic Services, 1999 - 1.11.7.1]

- **8.7.9.5 Unrelated items.** When there is no need to show a relationship between items, spatial coding should not be used. [Source: National Air Traffic Services, 1999 - 1.11.7.1]

8.7.10 Multidimensional coding

- **8.7.10.1 Three-dimensional effects.** Three-dimensional effects should be used in moderation on any single display, as overuse may be self-defeating. [Source: National Air Traffic Services, 1999 - 1.9.1.4]

8.8 Interaction

8.8.1 Interaction method

- **8.8.1.1 Selection of interaction type.** There are several interaction types listed below. The type of interaction selected shall be appropriate to the task requirements, the characteristics of the system, and the abilities of the users.

  a. The **question and answer** interaction type is appropriate when the task is routine data entry, the characteristics of the data are known and the question and answer sequence can be constrained, users are expected to have little or no training, and computer response is expected to be moderately fast.

  b. The **form filling** interaction type is appropriate when flexibility in data entry is needed, users are expected to be moderately trained, computer response may be slow, and an aid in composing complex control entries would be helpful.

  c. The **menu selection** interaction type is appropriate when tasks involve choices from constrained sets of alternatives, entry of arbitrary data is seldom required, users are expected to have little training, a command set is too large, too infrequent, or too inconsequential for users to remember, and computer response is relatively fast.

  d. The **function key** interaction type is appropriate for use in conjunction with other types of interaction method when tasks require only a limited number of control entries or when an immediate means for accomplishing frequent control entries or transactions is desirable.

  e. **The command language interaction type** is appropriate when tasks involve a wide range of control entries, users are expected to be highly trained or will use the system frequently, and control entries may be mixed with data entries in arbitrary sequence.

  f. The **query language** interaction type is appropriate when tasks emphasize unpredictable information retrieval and users are highly trained.

  g. The **constrained natural language** interaction type is appropriate when task requirements are wide-ranging or poorly defined and users are expected to have moderate training.

  h. The **direct manipulation** interaction type is appropriate when tasks mimic physical manipulation of concrete objects such as positioning graphical objects, moving blocks of text, and resizing objects. It is also appropriate for casual system users and users expected to have little or no training. [Source: MIL-HDBK-761A, 5.1.1.13; ESD-TR-86-278, 3.1.8.5]

- **8.8.1.2 Distinctive display of control information.** Displays shall be designed so that features such as prompts and messages relevant to the interactive method are distinctive in position and format. [Source: DOE HFDG ATCCS, V2.0, 2.1.10]

8.8.2 Hierarchical levels

- **8.8.2.1 Hierarchical levels.** When hierarchical levels are used to control a process or sequence, the number of levels shall be minimized. [Source: MIL-HDBK-761A, 5.1.1.3.d, 5.1.1.3.e]
- **8.8.2.2 Hierarchical levels format.** When hierarchical levels are used, display and input formats shall be similar within levels. [Source: MIL-HDBK-761A, 5.1.1.3.d, 5.1.1.3.e]
- **8.8.2.3 Hierarchical levels current position.** When hierarchical levels are used, the system shall indicate the current position within a sequence. [Source: MIL-HDBK-761A, 5.1.1.3.d, 5.1.1.3.e]

8.8.3 Question-answer

- **8.8.3.1 Consistency.** The format and question-answer procedures shall be consistent throughout an application and related applications. [Source: Nuclear Regulatory Commission, 1996 - 2.1-2]
- **8.8.3.2 Singular presentation of questions.** Users shall only be presented with and required to answer one question at a time. [Source: MIL-HDBK-761A, 5.1.2.a; MIL-STD-1801, 4.2.1.2.a]
- **8.8.3.3 List appropriate responses.** To the extent possible, users shall be provided a default or a list of the most appropriate responses from which they may select the desired response. [Source: MIL-HDBK-761A, 5.1.2.a; MIL-STD-1801, 4.2.1.2.a]
- **8.8.3.4 Display of interrelated answers.** When a system poses a series of questions to the user, and the answer to the current question is dependent upon how a previous question was answered, answers to all questions within the series should be displayed until all questions have been answered. [Source: MIL-HDBK-761A, 5.1.2.a; MIL-STD-1801, 4.2.1.2.b]
- **8.8.3.5 Sequence compatibility with source document.** When questions require entry of data from a source document, the question sequence shall match the data sequence within the source document. [Source: MIL-HDBK-761A, 5.1.2.c; MIL-STD-1801, 4.2.1.2.c]
- **8.8.3.6 Clarity.** Questions should be in clear, simple language. [Source: CTA, 1996 - 5.2.1]
- **8.8.3.7 Positive format.** Questions should be phrased in a positive manner. Avoid negative questions. [Source: CTA, 1996 - 5.2.1.1]

8.8.4 Form-filling

- **8.8.4.1 Consistency.** The structures and formats of form-filling interactions shall be consistent and logical throughout an application and related applications. [Source: MIL-HDBK-761A, 5.1.3.b]

- **8.8.4.2 Default entries.** Wherever possible, default entries shall appear in their fields when a form is displayed in form-filling interactions. [Source: MIL-HDBK-761A, 5.1.3.a]

- **8.8.4.3 Default listing.** A default listing or screen shall be provided in which authorized users may view and change default settings of fields. [Source: Smith & Mosier, 1986 – 6.3/15]

8.8.5 Menus

The use of menus as an interaction method is widespread, often in conjunction with other methods such as direct manipulation. Menus are usable with little or no training on the part of the user. If the meanings of the options are clear, the user can be guided step-by-step through an application. Menus do have some disadvantages, however; they can slow down an experienced user; they can occupy a considerable amount of display space; and, in complex sequences, users may become lost in the menu structure. [Source: DOE HFDG ATCCS, V2.0, 5.0; DOD HCISG V2.0, 6.0]

> **Definitions.** A **menu** is a list of options from which a user makes a selection or selections. An **option** is one of the selectable items in a menu. **Selection** is the action a user makes in choosing a menu option. Selection may be accomplished by pointing, by typing, or by pressing a function key. [Source: DOE HFDG ATCCS, V2.0, 5.0; DOD HCISG V2.0, 6.0]

8.8.5.1 General

- **8.8.5.1.1 Use.** Menus should be used for selecting values and choosing from a set of related options. [Source: DON UISNCCS, V1.2, 8.5.1.f]

- **8.8.5.1.2 Selecting a mutually exclusive option.** When users need to choose one option from a number of mutually exclusive options,

  a. **radio buttons** should be used for up to 6 options,

  b. a **menu** should be used for up to 10 options, and

  c. a **scrolling menu** should be used for more than 10 options. [Source: DON UISNCCS, V1.2, 8.5.1.b]

- **8.8.5.1.3 Menus distinct from other displayed information.** Menus shall be distinct from the other objects or information on the screen. [Source: MIL-HDBK-761A, 5.1.4.1.g; DOE HFDG ATCCS, V2.0, 5.1.5; MIL-STD-1801, 4.2.1.3.m; DoD HCISG V2 6.1.5]

- **8.8.5.1.4 Consistent style.** Menus throughout an application shall conform to a single style of interface (e.g., Microsoft Windows or Macintosh). [Source: DOE HFDG ATCCS, V2.0, 6.0]

- **8.8.5.1.5 Consistent menus and options.** When the same menu or option appears in different displays within an application, it shall be consistent in wording and organization. [Source: DOE HFDG ATCCS, V2.0, 5.2.1.2; DoD HCISG V2 6.2.1.2]

- **8.8.5.1.6 Instructions.** Instructions pertaining to menus shall appear in a Help window in a consistent location on the screen. [Source: DOE HFDG ATCCS, V2.0, 5.1.2; DOD HCISG V2.0, 6.1.2]

- **8.8.5.1.7 Menu width.** The menu should be wide enough for the longest menu item and its accelerator, ellipsis, or cascade indicator. [Source: Ameritech Services Inc., 1996 - 3.1.3.2.3]

  Definition. Accelerators are keyboard commands that can be used instead of pointing and clicking on menu options. They are indicated by underlining the proper character and placing the keyboard alternative in parenthesis after the option (e.g., Bold (Ctrl+B). [Source: National Air Traffic Services, 1999 - 1.10.3.1.9.2.9 and Definitions]

  Definition. . **Ellipses** are visual indicators, such as three dots (...), used to make menu options that branch to other sub-menus distinguishable from menu options that will immediately perform an operation. [Source: National Air Traffic Services, 1999 - Definitions]

- **8.8.5.1.8 Menu length.** The design of menus should take into account the response time and display rate of the system so that when the computer response time to a user action is long, menus have relatively more options (be broad and shallow); and when display rate is slow (if it takes a long time to complete the drawing of a display), menus have relatively fewer items (be narrow and deep). [Source: DOE HFDG ATCCS, V2.0, 6.1.1; DOD HCISG V2.0, 6.1.1]

8.8.5.2 Menu titles

- **8.8.5.2.1 Menu titles.** Menu titles and menu options shall be easily distinguishable. [Source: Ameritech Services Inc., 1996 - 3.1.3.2.2]

- **8.8.5.2.2 Titles for groups of options.** When the options in a menu are grouped and titled, the titles should be easy to understand and unique. [Source: DOE HFDG ATCCS, V2.0, 5.5.1.3; DoD HCISG V2 6.5.1.3; MIL-STD-1801, 4.2.1.3.o]

- **8.8.5.2.3 Appearance of group titles.** The titles of groups of options shall appear in a format that is clearly distinguishable from that of the options themselves. [Source: DOE HFDG ATCCS, V2.0, 5.5.1.4; DoD HCISG V2 6.5.1.4]

- **8.8.5.2.4 Distinguishing menu titles**. Menu titles shall be easily distinguished from the options. [Source: Ameritech Services Inc., 1996 - 3.1.3.2.2]

- **8.8.5.2.5 Numbering menu titles.** Menu titles shall not be numbered. [Source: MIL-HDBK-761A, 5.1.4.2.a ; Defense Information Systems Agency, 1995]

- **8.8.5.2.6 Capitalization in menu titles.** The first letter shall be capitalized, as well as other significant words, except for prepositions and articles. [Source: MIL-HDBK-761A, 5.1.4.2.a; Defense Information Systems Agency, 1995]

- **8.8.5.2.7 Acronyms in titles.** When the title contains an acronym, it shall be capitalized. [Source: Defense Information Systems Agency, 1995]

- **8.8.5.2.8 Menu titles as options.** The menu title shall not appear as an option in the menu. [Source: MIL-HDBK-761A, 5.1.4.2.a]

- **8.8.5.2.9 Ellipses and right arrows.** The menu title shall not contain ellipses or a right-pointing arrow. [Source: Defense Information Systems Agency, 1995]

8.8.5.3 Menu options

- **8.8.5.3.1 Highlighting menu options.** A menu option should be highlighted when the pointer is on the menu option. [Source: DOE HFDG ATCCS, V2.0, 5.4.2.3; DoD HCISG V2 6.4.2.3]

- **8.8.5.3.2 Option capitalization.** Options should be displayed in mixed case letters with only the first letter of the first word and acronyms capitalized. [Source: DON UISNCCS, V1.1, 4.1.2.2]

- **8.8.5.3.3 Number of selections per menu.** A user should be allowed to select only one option from a menu or menu group. [Source: MIL-HDBK-761A, 5.1.4.a]

- **8.8.5.3.4 Number of options.** The number of options in a menu should not be more than 10 or less than 3. [Source: MIL-HDBK-761A, 5.1.4.4.b]

- **8.8.5.3.5 Display of all options.** A menu should display explicitly and completely all options available to a user at the current step in a transaction sequence. [Source: MIL-HDBK-761A, 5.1.4.b; MIL-STD-1801, 4.1.1.3.1]

- **8.8.5.3.6 Distinguishing unavailable options.** When a menu contains options that are temporarily unavailable, the unavailable options shall be displayed but clearly distinguishable from available options. [Source: MIL-HDBK-761A, 5.1.4.c, 5.1.4.d]

  Example. Unavailable options might be displayed at reduced intensity (grayed out). [Source: MIL-HDBK-761A, 5.1.4.c, 5.1.4.d]

- **8.8.5.3.7 Menus with no available options.** When all the options on a menu are unavailable, then the menu title and all the options shall be disabled (grayed out). [Source: Ameritech Services Inc., 1996 - 3.1.3.2.3]

- **8.8.5.3.8 Disabled menu.** The user shall be able to pull down the menu to view its items even if the menu is disabled. [Source: Ameritech Services Inc., 1996 - 3.1.3.2.2]

- **8.8.5.3.9 Feedback for menu selection.** When no computer response is immediately observable when a user selects a menu option, the software shall provide some other acknowledgment of the selection. [Source: DOE HFDG ATCCS, V2.0, 5.4.1.3; DoD HCISG V2 6.4.1.3; MIL-HDBK-761A, 5.1.4.f; MIL-STD-1801, 4.2.1.3.g]

  Example. The software might display a watch, hourglass, or a message stating the delay remaining or the elapsed time. [Source: DOE HFDG ATCCS, V2.0, 5.4.1.3; DoD HCISG V2 6.4.1.3; MIL-HDBK-761A, 5.1.4.f; MIL-STD-1801, 4.2.1.3.g]

8.8.5.4 Types of options

- **8.8.5.4.1 Distinguishing types of options.** When a menu contains options of different types, the types shall be distinguishable. [Source: DOE HFDG ATCCS, V2.0, 5.3.3.5; DOD HCISG V2.0, 6.3.3.5; MIL-HDBK-761A, 5.1.4.4.i; MIL-STD-1801, 4.2.1.3.s]

  Example. Options that lead to other menus might be followed by a triangle that points to where the subsequent menu will appear (□ or ∇). A menu option that requires additional information from the user might be followed by an ellipsis (...). [Source: DOE HFDG ATCCS, V2.0, 5.3.3.5; DOD HCISG V2.0, 6.3.3.5; MIL-HDBK-761A, 5.1.4.4.i; MIL-STD-1801, 4.2.1.3.s]

- **8.8.5.4.2 Types of menu options**. There shall be no more than two types of options in a menu: attributes and commands. [Source: Apple Computer Inc., 1992 - p. 58]

  Definition. Attributes are instructions that change the characteristics of a selected item. An example of an attribute is changing text from standard to bold type. **Commands** are instructions that cause a device to perform some action. [Source: Apple Computer Inc., 1992 - p. 58]

- **8.8.5.4.3 Attribute options.** The title of attributes shall be adjectives or adjective phrases because these describe the specific feature of that attribute. [Source: Apple Computer Inc., 1992 - p. 58]

  Example. Choosing the option **Italic** changes the features of the selected text from normal to italic. [Source: Apple Computer Inc., 1992 - p. 58]

- **8.8.5.4.4 Command options.** The title of commands shall be verbs or verb phrases because they declare action. [Source: Apple Computer Inc., 1992 - p. 59]

  Example. The command **Save** causes the computer to save the data.

8.8.5.5 Wording of options

- **8.8.5.5.1 Worded as commands.** Options should be worded as commands to the computer, not questions to the user. [Source: DOE HFDG ATCCS, V2.0, 5.5.1.2; DoD HCISG V2 6.5.1.2; MIL-HDBK-761A, 5.1.4.2.b; MIL-STD-1801, 4.2.1.3.h]

  Example. The command **Copy** instructs the computer to copy selected data. [Source: Apple Computer Inc., 1992 - p. 58]

- **8.8.5.5.2 Terminology.** The wording of options shall use terminology familiar to the user but shall distinguish each option from every other option in the menu. [Source: DOE HFDG ATCCS, V2.0, 5.5.1.5; DoD HCISG V2 6.5.1.5]

- **8.8.5.5.3 Consistent with command language.** When menu selection is used in conjunction with command language interaction, the wording of menu options shall be consistent with the command language. [Source: DOE HFDG ATCCS, V2.0, 5.5.1.4; DoD HCISG V2 6.5.1.4]

  Definition. A **command language** is a limited programming language used strictly for executing a series of commands (e.g., Linux, any DOS shells). [Source: DOE HFDG ATCCS, V2.0, 5.5.1.4; DoD HCISG V2 6.5.1.4]

- **8.8.5.5.4 Terse wording.** Options should be tersely worded, preferably a single word. [Source: Apple Computer Inc., 1992 - p. 59]

- **8.8.5.5.5 Indicate changes.** The attribute option label should be worded to describe the changes that will occur to the selected text or object. [Source: Apple Computer Inc., 1992 - p. 59]

8.8.5.6 Option organization

- **8.8.5.6.1 Alignment of options.** With the exception of a menu bar, the options in a menu should be presented in a single vertical column, aligned and left justified. [Source: DOE HFDG ATCCS, V2.0, 5.2.1.9; DOD HCISG V2.0, 6.2.1.1, 6.2.1.9; MIL-HDBK-761A, 5.1.4.1.b; MIL-STD-1801, 4.2.1.3.b]

- **8.8.5.6.2 Separator lines.** A solid horizontal line the same color as the option labels should be placed between long, logically related groups of options. [Source: CTA, 1996 - 5.3.3.5]

- **8.8.5.6.3 Ordering a small number of options.** When a group of options or a menu contains a small number of options, the options shall be ordered by logical sequence or frequency of use. [Source: DOE HFDG ATCCS, V2.0, 5.2.1.5, 5.2.1.6; DOD HCISG V2.0, 6.2.1.5, 6.2.1.6]

- **8.8.5.6.4 Ordering a large number of options.** When a group of options or a menu contains a very large number of options, the options shall be ordered alphabetically. [Source: DOE HFDG ATCCS, V2.0, 5.2.1.5, 5.2.1.6; DOD HCISG V2.0, 6.2.1.5, 6.2.1.6]

- **8.8.5.6.5 Logical grouping of options.** When options are grouped in a menu, they shall be presented in logical groups. [Source: DOE HFDG ATCCS, V2.0, 5.2.1.3; DOD HCISG V2.0, 6.2.1.3]

- **8.8.5.6.6 Ordering of groups.** Groups of options in a menu shall be ordered logically and when there is no apparent logical ordering, ordered by their importance or expected frequency of use. [Source: DOE HFDG ATCCS, V2.0, 5.2.1.4; DOD HCISG V2.0, 6.2.1.4]

- **8.8.5.6.7 Default option.** The most likely selection in a menu list shall be made the default option. [Source: CTA, 1996 - 5.3.3.3.1]

- **8.8.5.6.8 Placing destructive command options.** When menu organization is based on such principles as frequency of use, the designer shall place destructive commands (**Delete, Exit**) at the bottom of the menu. [Source: CTA, 1996 - 5.3.3.4]

- **8.8.5.6.9 Placement of opposing action options.** The designer shall not place options for opposing actions adjacent to each other. [Source: CTA, 1996 - 5.3.3.6]

  Example. Do not place the **Delete** option next to the **Save** option. [Source: CTA, 1996 - 5.3.3.6]

- **8.8.5.6.10 Numbering menu options.** Menu options should not be numbered except when the task sequencing is important in an application window. [Source: DOE HFDG ATCCS, V2.0, 5.2.1.7; DoD HCISG V2 6.2.1.7]

8.8.5.7 Menu bars

- **8.8.5.7.1 When to use.** A menu bar should only be used if the display screen size and resolution permit fast and accurate movement of the cursor onto the options. [Source: DOE HFDG ATCCS, V2.0, 5.1.6.1; DOD HCISG V2.0, 6.1.6.1]

  Definition. A **menu bar** is a narrow panel, usually at the top of a computer screen in menu-based computer systems that continually displays the highest-level menu options for selection by the user. The options on a menu bar are usually the names of other menus. [Source: Ameritech Services Inc., 1996 - 3.1.3.2.1, National Air Traffic Services, 1999 - Definitions]

- **8.8.5.7.2 Menu bars for primary windows.** Primary windows should have menu bars that extend the full width of the primary window. [Source: Ameritech Services Inc., 1996 - 3.1.3.2.1]

  Definition. A **primary window** is a top or high-level window in an application. It is the main location of user interaction and functions independent of other primary windows in the application.

- **8.8.5.7.3 Visibility of menu bar options.** Menu bar options should remain visible at all times or until the user makes a selection. [Source: CTA, 1996 - 5.3.4.7]

- **8.8.5.7.4 Number of options.** Menu bars should contain no more than 10 options plus **Help**. [Source: DON UISNCCS, V1.2, 8.1.2]

- **8.8.5.7.5 Placement of options.** The options should begin at the left margin and extend to the right with **Help** located consistently, with enough space between them so that they can be read easily and accommodate the longest options in the pull-down menus. [Source: DON UISNCCS, V1.2, 8.1.2]

- **8.8.5.7.6 Duplicate options.** Options in window menu bars should not duplicate options in the system menu bar. [Source: DON UISNCCS, V1.2, 8.1.2]

- **8.8.5.7.7 Names of menu bar options.** Each menu that appears as an option in a menu bar should have a title that is unique in the application. [Source: DON UISNCCS, V1.2, 8.1.2]

- **8.8.5.7.8 Same menu bar in different windows.** When the same menu occurs in different windows, it should have the same title in each. [Source: DON UISNCCS, V1.2, 8.1.2]

- **8.8.5.7.9 Mnemonic.** Each title in a menu bar should have a mnemonic to permit selection from the keyboard. [Source: DON UISNCCS, V1.2, 8.1.2]

8.8.5.8 The system menu

- **8.8.5.8.1 System menu.** Each system should provide a system menu that includes options to end a session, print selections, review system status, define user preferences, manage alerts, change a password, access peripherals, and perform file management. [Source: DON UISNCCS, V1.2, 7.4.1]

- **8.8.5.8.2 Accessing system menu options.** System menu options should be available through a **System** option in the system menu bar. [Source: DON UISNCCS, V1.2, 7.4.1]

- **8.8.5.8.3 Organization of a system-level menu.** The options of a system-level menu shall be grouped, labeled, and ordered in terms of their logical function, frequency of use, and criticality. [Source: DOE HFDG ATCCS, V2.0, 5.3.3.2; DoD HCISG V2 6.3.3.2]

- **8.8.5.8.4 Availability of system-level menu options.** Appropriate system-level menu options shall always be available. [Source: DON UISNCCS, V1.2, 7.2.2]

- **8.8.5.8.5 Utilities menu.** A **Utilities** option should be included in the system menu bar to support the functionality provided by the system. [Source: DON UISNCCS, V1.2, 7.4.1]

  Example. Examples include such resources as word processing, spreadsheets, and electronic mail. [Source: DON UISNCCS, V1.2, 7.4.1]

8.8.5.9 The system menu bar

- **8.8.5.9.1 System window menu bar.** The set of options that appears in the system menu bar should describe the overall functionality of the system. [Source: DON UISNCCS, V1.2, 7.3.2]

- **8.8.5.9.2 System menu bar content.** The system menu bar shall list the titles of menus that are available at the system level which provide access to the application level programs available to the user. [Source: DON UISNCCS, V1.2, 7.2.1]

- **8.8.5.9.3 Consistent options and order across systems.** To the extent possible, menu bar options and their order in the system menu should be the same across systems. [Source: DON UISNCCS, V1.1, 7.2.3]

- **8.8.5.9.4 Consistent name across systems.** When the same application appears in different systems, it should have the same name in each system and be available in the same system-level menu. [Source: DON UISNCCS, V1.1, 7.2.3]

- **8.8.5.9.5 Access to Help.** When users are working in an application, they should be able to select **Help** from the system menu bar at any time. [Source: DON UISNCCS, V1.2, 7.3.5]

- **8.8.5.9.6 Navigation aid.** Each system should include a navigation aid accessible through **Help** that provides an overview of the system and allows users to navigate quickly to a particular part of the system. [Source: DON UISNCCS, V1.2, 7.3.6]

  Example. The system might provide a graphical representation of the system that would allow a user to select one part and have the appropriate window displayed on the screen. [Source: DON UISNCCS, V1.2, 7.3.6]

8.8.5.10 Pull-down menus

- **8.8.5.10.1 When to use.** Pull-down menus should be used rather than pop-up menus if the position of the cursor on the screen is not important for information or option retrieval. [Source: DOE HFDG ATCCS, V2.0, 5.1.7; DOD HCISG V2.0, 6.1.7]

  Definition. A **pull-down menu** is a menu associated with an option on a menu bar that appears when a menu bar option is selected.

  Discussion. Pull-down menus have limited applicability in data entry but may be useful for such activities as retrieving files. The advantage of pull-down menus over pop-up menus is that pull-down menus always have a visual cue in the form of a menu. [Source: DOE HFDG ATCCS, V2.0, 5.1.7; DOD HCISG V2.0, 6.1.7]

- **8.8.5.10.2 Consistent location.** Pull-down menus shall always appear immediately below the option whose selection leads to their appearance. [Source: MIL-HDBK-761A, 5.1.4.1.f]

- **8.8.5.10.3 Menu width.** The menu should be wide enough to accommodate the longest option and its keyboard accelerator, if present. [Source: DON UISNCCS, V1.2, 5.1]

- **8.8.5.10.4 Titles.** The title of a pull-down menu shall be the option on the menu bar with which the pull-down menu is associated. [Source: DON UISNCCS, V1.2, 5.1, 5.1.1.1]

- **8.8.5.10.5 Unique title.** The title of a pull-down menu shall be unique in the menu bar and, to the extent possible, describe or identify the options in the pull-down menu. [Source: DON UISNCCS, V1.2, 5.1, 5.1.1.1]

- **8.8.5.10.6 Outlining.** Pull-down menus should be outlined with a border or drop shadow. [Source: CTA, 1996 - 5.3.4.4]

- **8.8.5.10.7 Instructions.** Instructions should not be placed in pull-down menus. [Source: CTA, 1996 - 5.3.4.8]

- **8.8.5.10.8 Cascading pull-down.** When a pull-down option leads to a second-level, cascading pull-down, the option label should be followed with a right-pointing arrow. [Source: CTA, 1996 - 5.3.4.9]

- **8.8.5.10.9 Separators to divide groups of options.** Separators shall offset choice groups. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.1.1]

  Definition. A **group** on a pull-down menu is any set of menu items between two separators or the whole list if there are no separators on the pull-down menu. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.1.1]

- **8.8.5.10.10 Number of options.** The number of options in a pull-down menu should not be more than 10 or less than 3. [Source: DON UISNCCS, V1.2, 5.1.2.3]

- **8.8.5.10.11 Presentation of options.** The options in a pull-down menu should be displayed one option per line. [Source: DON UISNCCS, V1.2, 5.1]

- **8.8.5.10.12 Minimize scrolling.** To the extent possible, all options should be present to minimize scrolling. [Source: CTA, 1996 - 5.3.4.5]

- **8.8.5.10.13 Types of pull-down menu options.** The options in a pull-down menu shall be one of five types: commands, names of windows or forms that will be displayed, names of other menus, sets of exclusive options, or sets of nonexclusive options. [Source: DON UISNCCS, V1.2, 5.1.2.1]

- **8.8.5.10.14 Execution of commands.** Command options should be executed as soon as the user selects them. [Source: DON UISNCCS, V1.2, 5.1.2.1]

- **8.8.5.10.15 Names of windows or forms that will be displayed.** When names of windows or forms that will be displayed are used as options in pull down menus, they shall be identified by a special symbol, for example, an ellipsis (...).[Source: DON UISNCCS, V1.2, 5.1.2.1]

- **8.8.5.10.16 Names of other menus.** When names of other menus are used as options in a pull-down menu, they shall be identified by a special symbol, for example, an arrow (→) or triangle (>) that points to the location where the menu will appear. [Source: DON UISNCCS, V1.2, 5.1.2.1]

- **8.8.5.10.17 Sets of exclusive options.** Sets of exclusive options shall be identified by special symbol, for example, a filled circle (●) for the selected option and an open circle (○) for the unselected options. [Source: DON UISNCCS, V1.2, 5.1.2.1]

- **8.8.5.10.18 Sets of nonexclusive options.** Sets of nonexclusive options shall be identified by special symbols, for example, a marked square (☒) for the selected option(s), if any, and an open square (☐) for the unselected option(s), if any. [Source: DON UISNCCS, V1.2, 5.1.2.1]

- **8.8.5.10.19 Distinguishing unavailable options.** When a pull-down menu contains options that are temporarily unavailable, the unavailable options shall be displayed but clearly distinguishable from available options. [Source: DON UISNCCS, V1.2, 5.1.2.4, MIL-HDBK-761A, 5.1.4.c, 5.1.4.d]

  Example. Unavailable options might be displayed at reduced intensity (grayed out). [Source: DON UISNCCS, V1.2, 5.1.2.4, MIL-HDBK-761A, 5.1.4.c, 5.1.4.d]

- **8.8.5.10.20 Option selection.** A user should be able to select an option on a pull-down menu by moving the pointer onto the desired item and selecting it. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.1]

- **8.8.5.10.21 Exclusive option selection.** When only one option in a menu can be selected, a selection indicator should move to the chosen item and remain until another item is selected with the indicated menu item remaining in effect until another item is chosen. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.1]

- **8.8.5.10.22 Options requiring more user information.** When menu items on a pull-down menu require additional user information before the transaction can be completed, the designer shall follow each such item with ellipses (…).[Source: Ameritech Services Inc., 1996 - 3.1.3.2.5]

  Discussion. The ellipse indicates that a dialog box will result from selecting that item. [Source: Ameritech Services Inc., 1996 - 3.1.3.2.5]

8.8.5.11 Hierarchical menus

- **8.8.5.11.1 When to use.** Hierarchical menus should be used when there are more than 10 options and the options can be organized in a branching structure. [Source: DOE HFDG ATCCS, V2.0, 5.3.1; DoD HCISG V2 6.3.1; MIL-HDBK-761A, 5.1.4.4.a; MIL-STD-1801, 4.2.1.3.p]

  Definition. A **hierarchical menu** is a large series of options or menus that is organized as a multi-level, branching structure in which an option in a higher-level menu is the name of another menu at the next lower level. The options in the lowest level menus are not the names of other menus. They are commands, or selectable values such as color squares on a palette, or specific Auto Text choices (Dear Sir, To Whom It May Concern, etc.); [Source: DOE HFDG ATCCS, V2.0, 5.3.1; DoD HCISG V2 6.3.1; MIL-HDBK-761A, 5.1.4.4.a; MIL-STD-1801, 4.2.1.3.p]

- **8.8.5.11.2 Menu titles as options.** Designers should use a subset of menu titles in the pull-down menu as the option items in the hierarchical menu. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.1.2]

- **8.8.5.11.3 Organizing and labeling hierarchical menus.** Hierarchical menus should be organized and labeled to guide the user within the hierarchical structure. [Source: DOE HFDG ATCCS, V2.0, 5.3.2.1; DoD HCISG V2 6.3.2.1]

  Example. When a user selects an option from a hierarchical menu, the menu and the selected option remain on display with the selected option highlighted. The lower-level menu that results from the selection is displayed adjacent to the selected option. [Source: DOE HFDG ATCCS, V2.0, 5.3.2.1; DoD HCISG V2 6.3.2.1]

- **8.8.5.11.4 Consistent design and use.** The design and use of hierarchical menus shall be consistent across tasks and transactions within an application. [Source: DOE HFDG ATCCS, V2.0, 5.3.2.4; DoD HCISG V2 6.3.2.4; MIL-HDBK-761A, 5.1.4.4.g]

- **8.8.5.11.5 Minimum number of levels.** A hierarchical menu structure should minimize the number of selections required to reach the desired option. This implies the use of broad, shallow structures as opposed to narrow, deep ones. [Source: DOE HFDG ATCCS, V2.0, 5.3.4.1, 5.3.4.2; DoD HCISG V2 6.3.4.1 6.3.4.2]

- **8.8.5.11.6 Easy selection of important options.** Hierarchical menus should permit immediate user access to critical or frequently selected options. [Source: DOE HFDG ATCCS, V2.0, 5.3.2.2; DoD HCISG V2 6.3.2.2; MIL-HDBK-761A, 5.1.4.4.e]

- **8.8.5.11.7 Indicating current position in menu structure.** An indication of the user's current position in a hierarchical menu structure shall be provided. [Source: DOE HFDG ATCCS, V2.0, 5.3.2.3; DoD HCISG V2 6.3.2.3; MIL-HDBK-761A, 5.1.4.4.h]

- **8.8.5.11.8 Hierarchical menus in graphical user interfaces (GUI).** Hierarchical menus designed in a GUI should be as simple as possible avoiding complex graphical structures. [Source: DOE HFDG ATCCS, V2.0, 5.3.2.5; DoD HCISG V2 6.3.2.5]

- **8.8.5.11.9 Control entries.** The top-level menu in a hierarchical menu structure shall serve as a consistent starting point for control entries. [Source: DOE HFDG ATCCS, V2.0, 5.3.3.1; DoD HCISG V2 6.3.3.1; MIL-HDBK-761A, 5.1.4.4.c;MIL-STD-1801, 4.2.1.3.q]

  Definition. Control entries are user input for sequence control, such as function key activation, menu selection, and command entry. [Source: Carlow International Inc., 1992 - Glossary]

- **8.8.5.11.10 Top-level menu.** A user shall be able to return easily to the top-level menu in a hierarchical menu structure at any time. [Source: DOE HFDG ATCCS, V2.0, 5.3.3.1; DoD HCISG V2 6.3.3.1; MIL-HDBK-761A, 5.1.4.4.c;MIL-STD-1801, 4.2.1.3.q]

- **8.8.5.11.11 Return to system-level menu.** A user shall be able to return to a system-level menu from anywhere in a hierarchical menu structure with one simple control action. [Source: DOE HFDG ATCCS, V2.0, 5.3.3.3; DoD HCISG V2 6.3.3.3; MIL-HDBK-761A, 5.1.4.4.f]

- **8.8.5.11.12 Return to next higher level.** A user shall be able to return to the next higher-level menu from anywhere in a hierarchical menu structure with one simple control action**.** [Source: DOE HFDG ATCCS, V2.0, 5.3.3.4; DoD HCISG V2 6.3.3.4; MIL-HDBK-761A, 5.1.4.4.f]

- **8.8.5.11.13 Lower-level menus.** The options contained in a menu below the top level should be logically related to each other. [Source: MIL-HDBK-761A, 5.1.4.4.d]

- **8.8.5.11.14 Bypassing menu selections.** The system or application should allow a user to bypass a series of menu selections by making an equivalent command entry. [Source: DOE HFDG ATCCS, V2.0, 5.3.3.7; DoD HCISG V2 6.3.3.7; MIL-HDBK-761A, 5.1.4.3.1.e; MIL-STD-1801, 4.2.1.3.t]

  Definition. Command entries are a type of control entry that enables the user to initiate a message to the system that will specify desired functions. [Source: Carlow International Inc., 1992 - Glossary]

- **8.8.5.11.15 Software navigation aids.** Software navigation aids should be provided to assist the user in quickly selecting the desired menu (e.g., a tree diagram or organization chart) by permitting a user to select a menu directly without going through intermediate steps. [Source: DOE HFDG ATCCS, V2.0, 5.3.4.4; DoD HCISG V2 6.3.4.4]

- **8.8.5.11.16 Marking preferred menu locations.** The capability should be provided for the user to mark points in the menu structure where they might want to return and return to such a point by issuing a command. [Source: CTA, 1996 - 5.3.9.8.2]

8.8.5.12 Cascading menus

- **8.8.5.12.1 When to use.** Cascaded menus should be considered when the menu bar is crowded and the grouping of options is obvious to the user. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.1.2]

- **8.8.5.12.2 Cascading menus.** Cascading menus should follow the same guidelines as hierarchical menus. [Source: Microsoft Corp., 1992 - 5.1.3]

  Definition. A **cascading menu** is a type of hierarchical menu in which a submenu is attached to the right side of a menu item. Cascading menus can be added to drop-down menus, pop-up menus, or even other cascading menus. [Source: Microsoft Corp., 1992 - 5.1.3]

- **8.8.5.12.3 Cascade indicator.** Every cascaded menu item that leads to cascading menus shall be marked with a cascade indicator after the menu item name. [Source: Ameritech Services Inc., 1996 - 3.1.3.2.6]

  Discussion. The indicator is commonly a right pointing arrow (>) that is placed on the right side of the menu option items. This tells the user that a sub-menu exists for that item and that, when it is selected, the submenu will appear next to the item.

- **8.8.5.12.4 Number of levels.** Because cascaded menus require the user to remember where options are located or buried (the original menu may be partially hidden by the new cascaded menu), the number of levels should be limited to one. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.1.2]

8.8.5.13 Scrolling menus

- **8.8.5.13.1 When to use.** Scrolling capability shall be provided for menus used in data entry that are too long to display in their entirety (e.g., lists of retrievable files or acceptable entries for a filed). [Source: Apple Computer Inc., 1992 – p.78]

  Definition. A **scrolling menu** is a menu usually containing many options that does not display all of the options at once. It includes a scroll-bar that permits the sequential display of all options. Scrolling menus are also called list boxes and scrolling lists.

- **8.8.5.13.2 Scroll-bar.** The scroll-bar shall be placed at the right of the displayed options. [Source: DON UISNCCS, V1.2, 6.5]

- **8.8.5.13.3 Menu title.** When the menu has a title, it shall appear above the displayed options and be easily distinguishable from the options. [Source: DON UISNCCS, V1.2, 6.5]

- **8.8.5.13.4 Option display.** The displayed options in a scrolling menu shall be arranged vertically with one option per line. [Source: DON UISNCCS, V1.2, 6.5]

- **8.8.5.13.5 Order of options.** The options in a scrolling menu should be ordered in a way that minimizes user navigation. [Source: DON UISNCCS, V1.2, 6.5.1]

  Example. They might be ordered by expected frequency of use or in chronological or other sequential order. [Source: DON UISNCCS, V1.2, 6.5.1]

- **8.8.5.13.6 Alphabetical arrangement.** When ordering by expected frequency of use or in chronological or other sequential order is not appropriate, options should be ordered alphabetically. [Source: DON UISNCCS, V1.2, 6.5.1]

- **8.8.5.13.7 Display of all options in a scrolling menu.** All the options in a scrolling menu shall be available for explicit and complete display through scrolling. [Source: Apple Computer Inc., 1992 – p.78]

- **8.8.5.13.8 Indication of additional options.** It shall be obvious to users that there are more options than are visible. [Source: Apple Computer Inc., 1992 – p.78]

  Discussion. The presence of a scroll-bar may be sufficient to indicate the existence of additional options.

- **8.8.5.13.9 Search capability.** When a scrolling menu is large, for example, 50 options or more, the application should provide a search capability that would allow users to type a few characters of the option and search for those characters. [Source: DON UISNCCS, V1.2, 6.5.3]

- **8.8.5.13.10 Spin box.** A spin box should be used only for highly predictable discrete sets of options. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.3.2]

  Definition. A **spin box** (also known as a **spin button**) is a variation of the scrolling menu or list. A spin box is made up of a text box and two arrows and displays a sequence of mutually exclusive choices. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.3.2]

8.8.5.14 Pop-up menus

Pop-up menus can be very useful in data entry. They can present to a user the permissible entries for a field thus eliminating the need for the user to remember the entries, preventing invalid entries, and eliminating potential typing errors. A pop-up menu resembles a pull-down menu, but it is not associated with the top-level menus listed in the menu bar. [Source: CTA, 1996 - 5.3.5]

- **8.8.5.14.1 Pop-up menus.** Pop-up menus should follow the guidelines for standard pull-down menus, except they do not have a title. [Source: Microsoft Corp., 1992 - 5.1.2]

  Definition. Pop-up menus are menus that only appear on user demand. They are often associated with a particular object on a display, (e.g., a pop-up menu listing acceptable command options close to the immediate work area). Because they are not displayed all of the time, they do not take up valuable screen space. They provide an efficient way to access commands because they eliminate the need for the user to navigate to a menu bar or control bar. A pop-up menu typically contains 5 to 10 options presented in a vertical listing. [Source: Microsoft Corp., 1992 - 5.1.2]

- **8.8.5.14.2 Attribute lists.** Pop-up menus should not be used for accumulating attribute lists such as text style choices. [Source: Apple Computer Inc., 1992 – pp. 86]

- **8.8.5.14.3 Actions**. Pop-up menus should not be used as a means of providing more commands; therefore, they should not contain actions (verbs). [Source: Apple Computer Inc., 1992 – pp. 86]

- **8.8.5.14.4 Distinguishing the pop-up menu.** The pop-up menu should be made distinct from the screen background by giving it a contrasting yet complementary background or by giving it a solid-line border. [Source: CTA, 1996 - 5.3.5.5]

- **8.8.5.14.5 Title.** A title shall be displayed for each pop-up menu. [Source: CTA, 1996 - 5.3.5.3]

- **8.8.5.14.6 Pop-up menu location.** A pop-up menu shall be placed directly below the pointer used to select it and near the object or higher-level menu that is being manipulated. [Source: CTA, 1996 - 5.3.5.2]

- **8.8.5.14.7 Indication of pop-up menu.** An indication or cue shall be provided to the existence of a pop-up menu. [Source: DOE HFDG ATCCS, V2.0, 5.1.8.1; DOD HCISG V2.0, 6.1.8.1]

  Example. Highlight the portion of the display that can be selected to access the hidden menu, provide a textual message indicating that a hidden menu is available, or change the shape of the cursor when it is located in a selectable area.

- **8.8.5.14.8 Selecting an option using a pointing device.** A user shall be able to select an option on a pop-up menu by moving the pointer onto the desired option and clicking the appropriate button**.** [Source: DOE HFDG ATCCS, V2.0, 5.1.8.2; DOD HCISG V2.0, 6.1.8.2]

  Explanation. This method is preferred to holding the button down while moving the cursor and releasing it to make a selection. The deliberate click method is less prone to error. [Source: DOE HFDG ATCCS, V2.0, 5.1.8.2; DOD HCISG V2.0, 6.1.8.2]

- **8.8.5.14.9 Selection highlighting.** When an option in a pop-up menu remains on display after it has been selected, it should remain highlighted. [Source: DOE HFDG ATCCS, V2.0, 5.1.8.3; DOD HCISG V2.0, 6.1.8.3]

- **8.8.5.14.10 Pop-up menus leading to cascading menus.** When an option in a pop-up menu leads to a cascading menu, a right-pointing triangle (►) should be placed after the option label. [Source: CTA, 1996 - 5.3.5.4]

- **8.8.5.14.11 Options leading to cascading menus.** Selected options that lead to a cascading menu should remain highlighted and serve as the title for the cascading menu. [Source: CTA, 1996 - 5.3.5.4]

- **8.8.5.14.12 Type-in pop-up menus.** When a list of likely choices is displayed in a pop-up menu, the user should be able to type in a choice that was not anticipated. [Source: Apple Computer Inc., 1992 – p. 91]

  Discussion. In this situation, making all preset choices visible allows the user to make a selection from the list provided. For example, when choosing screen magnification size, the user should be able to pick from a list of suggested sizes or type in a specific value. [Source: Apple Computer Inc., 1992 – p. 91]

8.8.5.15 Tear-off menus

- **8.8.5.15.1 When to use.** A graphic tear-off menu should be used instead of a fixed palette when it can save display space and provide greater flexibility. [Source: CTA, 1996 - 5.3.8.2]

  Definition. A **tear-off menu** is a menu that can be removed from the menu bar and moved to another location on the screen where it can remain on display. Tear-off menus are also called "tacked" or "pushpin" menus. [Source: CTA, 1996 - 5.3.8]

- **8.8.5.15.2 Location.** Tear-off menus should be placed so that the user can make multiple selections before dismissing it. [Source: CTA, 1996 - 5.3.8.1]

- **8.8.5.15.3 Moving and re-sizing.** The user should have the capability to move and re-size the tear-off menu. [Source: CTA, 1996 - 5.3.8]

8.8.5.16 Toggled menus

- **8.8.5.16.1 Toggled menu options.** Toggled menu options shall be used for two and only two opposite commands that are accessed frequently. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.5.1]

  Definition. Toggled menu options are used to issue commands as a binary selection of one of two opposite commands. . [Source: Ameritech Services Inc., 1996 - 4.1.1.1.5.1]

- **8.8.5.16.2 Naming toggled menu options.** Toggled menu options shall begin with verbs that clearly state the outcome of selecting that menu item. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.5.1]

8.8.5.17 Graphic menus

Definition. Graphic menus (palettes) are a set of unlabeled symbols, typically presented within small rectangles. Symbols may be icons, patterns, characters, or drawings that represent an operation. Palettes are used widely in drawing and painting packages but are commonly found in word-processing applications as well. [Source: CTA, 1996 - 5.3.7]

- **8.8.5.17.1 Symbols**. Symbols within graphic palettes should be labeled unless they are self-explanatory. [Source: CTA, 1996 - 5.3.7.1]
- **8.8.5.17.2 Mode indicator.** Upon selection of a symbol or tool, a reminder should be displayed to indicate the mode that has been activated. [Source: CTA, 1996 - 5.3.7.2]
- **8.8.5.17.3 Moving and re-sizing.** The user should have the capability to move and re-size the palette. [Source: CTA, 1996 - 5.3.7.3]

8.8.6 Menu Interaction

8.8.6.1 Selecting options

- **8.8.6.1.1 Equivalence of input devices.** The system or application shall provide a user with the ability to use any of the input devices available to select a menu option. [Source: DOE HFDG ATCCS, V2.0, 5.4.1.3; DoD HCISG V2 6.4.1.3]

  Example. When a user has both a pointing device and a keyboard available, he or she can use either to select an option. [Source: DOE HFDG ATCCS, V2.0, 5.4.1.3; DoD HCISG V2 6.4.1.3]

- **8.8.6.1.2 Initial cursor position for keyboards.** When a user must select among displayed options using a keyboard, the cursor shall be placed on the default option in the control entry area (with that control entry area having implicit input focus) when the display appears. [Source: DOE HFDG ATCCS, V2.0, 5.4.1.5; DoD HCISG V2 6.4.1.5; MIL-HDBK-761A, 5.1.4.3.2.c; MIL-STD-1801, 4.2.1.3.f]
- **8.8.6.1.3 Selection by pointing.** When menu selection is the primary interactive method, and especially when selections are made from extensive lists of options, selection by pointing device should be provided. [Source: DOE HFDG ATCCS, V2.0, 5.4.2.1; DoD HCISG V2 6.4.2.1]
- **8.8.6.1.4 Method of selecting by pointing.** The method for selecting an option by pointing should be that of moving the cursor onto the desired option and clicking the select button on the pointing device. [Source: DOE HFDG ATCCS, V2.0, 5.1.8.2; DoD HCISG V2 6.1.8.2]

- **8.8.6.1.5 Initial cursor position for pointing devices.** When a user must select among displayed options using a pointing device, the cursor shall be placed on the default option when the display appears. [Source: DOE HFDG ATCCS, V2.0, 5.4.1.1; DoD HCISG V2 6.4.1.1; MIL-HDBK-761A, 5.1.4.3.1.d]

- **8.8.6.1.6 Size of selectable area.** The effective pointing area for menu options should be as large as is consistently possible. [Source: DOE HFDG ATCCS, V2.0, 5.4.2.2; DoD HCISG V2 6.4.2.2]

  Explanation. The pointing area for a menu option is the area in which the user can place the cursor with a pointing device to select that particular option.

- **8.8.6.1.7 Minimum pointing area size.** The effective pointing area for menu options shall be at least the displayed option label plus a half-character distance around that label. [Source: DOE HFDG ATCCS, V2.0, 5.4.2.2; DoD HCISG V2 6.4.2.2]

- **8.8.6.1.8 Two-action activation.** When menu selection is accomplished with a pointing device, activation shall consist of two actions: (1) designation, in which a user positions the cursor on the desired option, and (2) activation, in which a user makes a separate, explicit control entry (clicking the appropriate mouse button). [Source: DOE HFDG ATCCS, V2.0, 5.4.2.3; DoD HCISG V2 6.4.2.3]

- **8.8.6.1.9 Shortcuts.** Shortcut methods should be provided for experienced users to bypass the menu structure for frequently accessed options. [Source: DOE HFDG ATCCS, V2.0, 5.0; DoD HCISG V2 6.0]

- **8.8.6.1.10 Abbreviated entries.** When menu selection is by code entry, the application should accept both the complete and minimum distinguishing abbreviated forms of the code. [Source: DOE HFDG ATCCS, V2.0, 5.4.1.6; DoD HCISG V2 6.4.1.6]

  Example. An application might accept **Q, QU,** and **QUIT** as equivalent. [Source: DOE HFDG ATCCS, V2.0, 5.4.1.6; DoD HCISG V2 6.4.1.6]

- **8.8.6.1.11 Stacking menu selections.** When the selection of options from menus is accomplished by entering codes, and when a series of selections can be anticipated before the menus themselves are displayed, the user shall be able to combine selections into a single, stacked entry that is equivalent to the series of selections but without having the menus displayed. [Source: DOE HFDG ATCCS, V2.0, DoD HCISG V2 6.1.4]

  Definition. Stacking is the stringing together of commands so that they can all be executed with a single command. [Source: DOE HFDG ATCCS, V2.0, DoD HCISG V2 6.1.4]

8.8.6.2 Mnemonic coding and keyboard accelerators in menus

- **8.8.6.2.1 When to use.** Each menu title and each option in a menu should have a mnemonic. [Source: DON UISNCCS, V1.2, 5.1]

  Definition and discussion. A **mnemonic** is a single letter that a user can type to select an option in a menu. Mnemonic letters are the easiest codes to remember because numbers are more difficult. Non-mnemonic letters are the most difficult. Letters as codes also have a numerical advantage over numbers (there are 26 letters as opposed to only 10 numbers). Numbers have the advantages of making sequencing clear, being easier to locate on a keyboard by non-typists, and allowing a user to know immediately how many options are available.

- **8.8.6.2.2 Appointing a mnemonic.** The mnemonic for an option shall be different from any other mnemonic in the menu**.** [Source: DON UISNCCS, V1.2, 5.1.2.5]

  Discussion. The preferred letter is the first letter. However, when that letter is used as another mnemonic in the menu or associated menus, another letter, preferably the second character letter may be used. [Source: DON UISNCCS, V1.2, 5.1.2.5]

- **8.8.6.2.3 Mnemonic and keyboard accelerator.** The mnemonic for an option should use the same letter in the keyboard accelerator if there is one that includes a letter. [Source: Ameritech Services Inc., 1996 - 3.1.3.2.4]

  Definition. A **keyboard accelerator** is a key or simultaneous combination of keys that a user can type to select an option in a menu without having to display the menu. Both mnemonics and accelerators are shortcuts that a user can type from the keyboard. [Source: DON UISNCCS, V1.2, 5.1.2.5]

  Example. S might be the mnemonic for a **Save** option, and the simultaneous pressing of **Ctrl** and the letter **S** might be its keyboard accelerator. [Source: Ameritech Services Inc., 1996 - 3.1.3.2.4]

- **8.8.6.2.4 Underlining mnemonic.** The mnemonic for an option shall be underlined. [Source: DON UISNCCS, V1.2, 5.1.2.5]

- **8.8.6.2.5 Displaying mnemonics and accelerators.** Mnemonics and accelerators shall be displayed as part of the menu option. Exhibit 8.8.6.2.5 shows one way of indicating mnemonics (the underscored letters) and accelerators (the key combinations at the right). [Source: DON UISNCCS, V1.2, 2.3.1]

Exhibit 8.8.6.2.5

Mnemonics	Accelerators
Undo	Ctrl + Z
Cut	Ctrl + X
Copy	Ctrl + C
Paste	Ctrl + V
Clear	Del

- **8.8.6.2.6 Using a number as an accelerator.** When menu items are numbered, the number should be underlined and used as the mnemonic. [Source: Ameritech Services Inc., 1996 - 3.1.3.2.3 and 3.1.3.2.4]

  Discussion. The difference between a mnemonic and an accelerator is that choosing an option with a mnemonic requires the user to type the single letter mnemonic while the menu is displayed. When using an accelerator to choose an option, the user must type a key or simultaneous combination of keys. However, the menu does not have to be displayed.

- **8.8.6.2.7 Letter vs. numeric codes.** Letter and numeric codes should not be used in the same menu. [Source: DOE HFDG ATCCS, V2.0, 5.5.2.2; DOD HCISG V2.0, 6.5.2.2]

- **8.8.6.2.8 Numbering menu options.** When menu options are numbered, numbering shall start with 1, not with 0. [Source: DOE HFDG ATCCS, V2.0, 5.5.2.4; DOD HCISG V2.0, 6.5.2.4]

- **8.8.6.2.9 Numeric coding.** When using numeric codes, six or fewer characters shall be used. [Source: CTA, 1996 - 4.2.3.1]

- **8.8.6.2.10 Displaying option codes.** When menu options are coded, the codes shall be displayed with their options in a consistent, distinctive manner. [Source: DOD HCISG V2.0, 6.5.2.6; MIL-HDBK-761A, 5.1.4.3.1.f]

  Examples. When numeric coding is used, the numerals might appear immediately to the left of the options. When mnemonic coding is used, the mnemonic letter or letters might be boldfaced (**Undo**) or underlined (Undo). [Source: DOD HCISG V2.0, 6.5.2.6; MIL-HDBK-761A, 5.1.4.3.1.f]

- **8.8.6.2.11 Keyboard accelerators.** Applications should provide keyboard accelerators (or hot keys) for frequently selected menu options. [Source: DON UISNCCS, V1.2, 5.1.2.5]

- **8.8.6.2.12 Keyboard accelerators in the menu.** Keyboard accelerators should appear right justified on the same line as the option in the menu, separated by enough space to appear visually distinct, as seen in Exhibit 8.8.6.2.5. [Source: DON UISNCCS, V1.2, 5.1.2.5]

- **8.8.6.2.13 Selecting an option in a menu using its accelerator.** When a menu has accelerators, a user shall be able to select an option in the menu by typing its accelerator. [Source: DON UISNCCS, V1.2, 3.2.2.4]

- **8.8.6.2.14 Case sensitivity of mnemonics and keyboard accelerators**. Mnemonics and keyboard accelerators shall not be case sensitive, with upper and lower case letters being equivalent. [Source: DON UISNCCS, V1.2, 5.1.2.5]

8.8.7 Function keys

- **8.8.7.1 When to use.** Function keys should be used for tasks requiring only a limited number of control entries or for use in conjunction with other dialogue types as a ready means of accomplishing critical entries that must be made quickly without syntax error. [Source: Smith & Mosier, 1986 - 3.1.4]

  Definition. Function keys are labeled keys that serve as keyboard short cuts (e.g., F1, F2, F3, or with the function name such as Delete or Insert) by combining in one key the actions of a sequence of individual keys. [Source: National Air Traffic Services, 1999 - Definitions]

- **8.8.7.2 Single function.** When feasible, a function key should be assigned only one function. [Source: DOE HFDG ATCCS, V2.0, 4.1.4]

- **8.8.7.3 Consistency within an application.** When the same function is used in different operational modes within an application, it shall be assigned the same key for all modes. [Source: DOE HFDG ATCCS, V2.0, 4.2.1; MIL-HDBK-761A, 5.1.7.5.b; MIL-STD-1801, 4.2.1.4.e]

- **8.8.7.4 Consistency across applications.** When the same function is used in related applications, it shall be assigned to the same key in all applications. [Source: DOE HFDG ATCCS, V2.0, 4.2.2]

- **8.8.7.5 Feedback.** Feedback, such as a text message or audible signal, shall be provided to the user for function key activation. [Source: DOE HFDG ATCCS, V2.0, 4.1.2; MIL-HDBK-761A, 5.1.7.3.a, 5.1.7.3.b; MIL-STD-1801, 4.1.1.4.c]

- **8.8.7.6 Soft function keys.** When soft function keys are used, representations of the function keys with the same spatial configuration as the hard function keys should be presented on the screen as near as possible to the hard keys. [Source: DOE HFDG ATCCS, V2.0, 4.1.5]

  Definition. A **soft function key** is an area on the screen that represents a function key. If a function key is assigned more than one function in an application, an associated soft key can be labeled with the function that is currently assigned to the key. A **hard function key** is the physical function key on the keyboard.

- **8.8.7.7 Soft function key activation.** When activating a soft function key with a pointing device, the user should be able to initiate the function both by pressing the corresponding hard function key on the keyboard and by selecting the soft key on the screen with the pointing device. [Source: DOE HFDG ATCCS, V2.0, 4.1.6]

- **8.8.7.8 Disabling of unused function keys.** Function keys that are unassigned or that are assigned a function that is not applicable at the moment shall be disabled. [Source: MIL-HDBK-761A, 5.1.7.1.c; DOE HFDG ATCCS, V2.0, 4.1.3, 4.1.7; MIL-STD-1801, 4.2.1.4.d]

- **8.8.7.9 Indicating active function keys.** When some function keys are active and some are not, the active keys shall be indicated. [Source: MIL-HDBK-761A, 5.1.7.1.c; DOE HFDG ATCCS, V2.0, 4.1.3, 4.1.7; MIL-STD-1801, 4.2.1.4.d]

  Discussion. This might be done by displaying only the active keys as soft keys on the screen or by displaying active soft keys differently from inactive ones. [Source: MIL-HDBK-761A, 5.1.7.1.c; DOE HFDG ATCCS, V2.0, 4.1.3, 4.1.7; MIL-STD-1801, 4.2.1.4.d]

- **8.8.7.10 Easy return to base-level functions.** When the functions assigned to a set of keys change as a result of user selection, it shall be easy for the user to return them to the initial, base level functions. [Source: DOE HFDG ATCCS, V2.0, 4.1.9; MIL-HDBK-761A, 5.1.7.5.c]

  Discussion. One way this might be done is to include the equivalent of a "Main Menu" key in all sets other than the base set of function keys. [Source: DOE HFDG ATCCS, V2.0, 4.1.9; MIL-HDBK-761A, 5.1.7.5.c]

- **8.8.7.11 User-defined functions (macros).** When desirable, users should be able to define their own functions and assign them to function keys, either temporarily or permanently. [Source: MIL-HDBK-761A, 5.1.7.5.d]

  Discussion. The capability to define functions should not be provided if macros defined by one user might be used inadvertently by another user. [Source: MIL-HDBK-761A, 5.1.7.5.d]

- **8.8.7.12 Single-key operation for continuously available functions.** When a function is available continuously, pressing its assigned function key or selecting a corresponding soft key shall initiate it. [Source: DOE HFDG ATCCS, V2.0, 4.6.2; MIL-HDBK-761A, 5.1.7.5.a]

- **8.8.7.13 Frequently used functions.** When a function will be used frequently, when its use is critical, or when its timely use is critical, it shall be initiated with a single key operation. [Source: DOE HFDG ATCCS, V2.0, 4.6.3; MIL-HDBK-761A, 5.1.7.2.a]

- **8.8.7.14 Importance and frequency of use.** Functions shall be assigned to keys in accordance with their importance and frequency of use. [Source: DOE HFDG ATCCS, V2.0, 4.5.1; MIL-HDBK-761A, 5.1.7.4.b]

  Example. An emergency function might be given the most prominent position, or the most frequently used function might be given the most convenient location. [Source: DOE HFDG ATCCS, V2.0, 4.5.1; MIL-HDBK-761A, 5.1.7.4.b]

- **8.8.7.15 Single key press.** A function key shall perform its labeled function with a single press of the function key. [Source: DOE HFDG ATCCS, V2.0, 4.6.1; MIL-HDBK-761A, 5.1.7.2.c; MIL-STD-1801, 4.2.1.4.b]

- **8.8.7.16 Repeated key presses.** Function keys shall not change function with repeated key presses unless there is a change in mode, and only after indication of the new function. [Source: DOE HFDG ATCCS, V2.0, 4.6.1; MIL-HDBK-761A, 5.1.7.2.c; MIL-STD-1801, 4.2.1.4.b]

- **8.8.7.17 Relationship of functions assigned to the same key.** When two or more sets of functions are assigned to function keys and they are accessed by simultaneously pressing a function key and another key, such as **Shift, Ctrl,** or **Alt,** the logical relationship should be consistent from one set of functions to another. [Source: DOE HFDG ATCCS, V2.0, 4.3.2; MIL-HDBK-761A, 5.1.7.2.b]

  Example. In a text processing application, one set of functions might apply to lines, another to paragraphs, and another to pages. [Source: DOE HFDG ATCCS, V2.0, 4.3.2; MIL-HDBK-761A, 5.1.7.2.b]

- **8.8.7.18 Labeling single-function keys.** A function key assigned a single function shall have a label on the keycap that clearly identifies the function and clearly distinguishes that function from others. [Source: DOE HFDG ATCCS, V2.0, 4.4.1; MIL-HDBK-761A, 5.1.7.1.a; MIL-STD-1801, 4.2.1.4.a]

- **8.8.7.19 Labeling multifunction keys.** When a key is used for more than one function, the user shall be informed which function is currently available. [Source: DOE HFDG ATCCS, V2.0, 4.4.2; MIL-HDBK-761A, 5.1.7.1.b; MIL-STD-1801, 4.2.1.4.a]

  Discussion. One way to accomplish this is to display a label on a soft key on an adjacent portion of the screen. [Source: DOE HFDG ATCCS, V2.0, 4.4.2; MIL-HDBK-761A, 5.1.7.1.b; MIL-STD-1801, 4.2.1.4.a]

- **8.8.7.20 Easy re-labeling.** Provisions shall be made for easy re-labeling of variable function keys. [Source: Department of Defense, 1996 - 5.15.2.4.4]

- **8.8.7.21 Labels of keys with changing functions.** Labels for variable function keys located along the perimeter of a display should be generated on the display face as a soft key when users or system administrators will change the functions often. [Source: Department of Defense, 1996 - 5.15.2.4.4, 5.15.2.4.6]

- **8.8.7.22 Shifted characters.** Shift keys should not be used to operate variable function keys. [Source: Department of Defense, 1996 - 5.15.2.4.5]

- **8.8.7.23 Indicating status.** When applicable, the active or inactive status of a function key shall be indicated. [Source: MIL-HDBK-761A, 5.1.7.1.c]

  Example. One way to accomplish this is to change the appearance of displayed labels on the screen. An example would be dimming inactive keys or displaying one state in dark text on a light background and the reverse for the other state. [Source: MIL-HDBK-761A, 5.1.7.1.c]

- **8.8.7.24 Labeling of menu items selectable with function keys.** When items from a menu are to be selected using function keys, the items should be labeled with function key numbers (e.g., **F1** and **F2**), and appear as soft key labels above the function keys when screen real estate is not at a premium. [Source: DOE HFDG ATCCS, V2.0, 4.4.3]

- **8.8.7.25 Safeguarding.** Function keys that have potentially disruptive consequences shall be safeguarded. Safeguarding may take the form of physical protection, software disabling, interlocks, or multiple key combinations. [Source: DOE HFDG ATCCS, V2.0, 4.5.2; MIL-HDBK-761A, 5.1.7.4.d]

8.9 General interactive techniques

8.9.1 Direct manipulation

- **8.9.1.1 When to use.** Direct manipulation should be used for casual system users as a means of enhancing a user's understanding of control actions and offered as a simple alternative to learning a command language when computer response time is fast. [Source: Nuclear Regulatory Commission, 1996 - 2.2.6-5]

  Definition. In a graphical user interface (GUI), a major type of interactive dialog is direct manipulation. In a direct manipulation dialog, the user controls the interface with the computer by acting directly on objects on the display screen. An object may be an icon, menu option, symbol, button, or dialog box. [Source: DOE HFDG ATCCS, V2.0, 6.0]

- **8.9.1.2 Direct manipulation interface.** The direct manipulation interface should include windows for containing the data file and menus for additional objects and actions that are not easily represented by pictographic icons. [Source: Nuclear Regulatory Commission, 1996 - 2.2.6-4]

- **8.9.1.3 Drag transfer.** When a system provides direct manipulation, a user should be able to move and copy data and objects by first marking the data or object, if necessary, then placing the pointer on it, holding down the appropriate button on the pointing device, and dragging it to the desired location. [Source: DON UISNCCS, V1.2, 3.5.1]

8.9.2 Command language

- **8.9.2.1 When to use.** Command language should be used

  a. for tasks involving a wide range of control entries,

  b. where users may be highly trained and will use the system frequently, and

  c. for tasks where control entries may be mixed with data entries in arbitrary sequence. [Source: Smith & Mosier, 1986 - 3.1.5.1]

  Definition. A **command language** is a limited programming language used strictly for executing a series of commands (e.g., Linux, DOS prompt). [Source: MIL-STD-1801, 4.2.1.5.b]

- **8.9.2.2 Command entry.** A command language shall be designed so that users can enter commands in terms of functions desired without concern for internal computer processing, storage, and retrieval mechanisms. [Source: MIL-STD-1801, 4.2.1.5.b]

- **8.9.2.3 Consistent syntax.** Command language syntax shall be consistent within an application and across related applications. [Source: MIL-HDBK-761A, 5.1.5.2.d]

  Definition. The **syntax** of a command language is the set of rules governing the language. Examples would be rules about the order in which parts of a command occur or rules about punctuation in commands (e.g., options in DOS are preceded by a backslash). [Source: MIL-HDBK-761A, 5.1.5.2.d]

- **8.9.2.4 Complexity of command language.** The complexity of a command language should be minimized, especially for untrained or infrequent users. [Source: MIL-HDBK-761A, 5.1.5.2.c]

- **8.9.2.5 Organization of command language features.** The command language shall be designed so that its features (functions) are organized in groups for ease of learning and use. [Source: MIL-HDBK-761A, 5.1.5.2.b: MIL-STD-1801, 4.2.1.5.c]

  Example. Enable the user to display the next of a set of received messages with some simple command such as READ NEXT, instead of entering the complete command to retrieve a message that might include specification of message, message list, format, and output device.

- **8.9.2.6 Command stacking.** Users should be able to make control entries in accordance with task requirements, entering more than one command before entering an execute command, if that best meets the task requirements. [Source: DOE HFDG ATCCS, V2.0, 2.1.14.3]

  Definition. Stacking is the stringing together of commands so that they can all be executed with a single command. **Control entries** are a specific set of commands defined by the command language.

- **8.9.2.7 Command entry area.** Each display shall provide a command entry area that is located consistently across displays, for example, at the bottom of the screen. [Source: MIL-HDBK-761A, 5.1.5.2.a; MIL-STD-1801, 4.2.1.5.a]

- **8.9.2.8 Distinctive wording of commands.** Words in a command language shall be distinctive from one another, emphasizing significant differences in function. [Source: MIL-HDBK-761A, 5.1.5.1.a, 5.1.5.1.b, 5.1.5.1.f; MIL-STD-1801, 5.2.1.5.f]

- **8.9.2.9 Consistent wording of commands.** All words and their abbreviations in the command language shall be consistent in meaning and spelling from one transaction to another and from one task to another. [Source: MIL-STD-1801, 4.2.1.5.d]

- **8.9.2.10 Familiar wording.** Words for use in command language dialog shall be chosen to reflect the user's point of view and shall correspond to the user's operational language. [Source: MIL-STD-1801, 4.2.1.5.d]

- **8.9.2.11 Abbreviation of commands.** When a command language is necessary for the system and if the operators may be experienced users, then commands should also have abbreviated forms having five or less characters. [Source: MIL-HDBK-761A, 5.1.5.3.c]

- **8.9.2.12 Selection of commands.** Commands should be designed to aid memory. [Source: MIL-HDBK-761A, 5.1.5.1.c]

- **8.9.2.13 Alternate wording.** When a system will have many novice or infrequent users, it should recognize a variety of synonyms or alternative syntax for each word defined in the command language. [Source: MIL-HDBK-761A, 5.1.5.1.d]

- **8.9.2.14 Spelling errors.** Commands shall be selected so that likely spelling errors do not result in valid commands. [Source: MIL-HDBK-761A, 5.1.5.1.e]

  Example. Using **DEL** for Delete and **SEL** for Select might result in a spelling-induced error because the D and S keys are adjacent on QWERTY keyboards. [Source: MIL-HDBK-761A, 5.1.5.1.e]

- **8.9.2.15 Word length.** The length of an individual input word, such as a command or a key word, should not exceed seven characters. [Source: MIL-HDBK-761A, 5.1.1.7.e]

- **8.9.2.16 Number of characters** Commands shall have at least one alphabetic or numeric character. [Source: MIL-HDBK-761A, 5.1.5.1.g]

- **8.9.2.17 Non-alphanumeric characters in commands.** Commands consisting of only non-alphanumeric characters (e.g., $ or @) shall not be used. [Source: MIL-HDBK-761A, 5.1.5.1.g]

- **8.9.2.18 Punctuation.** The use of punctuation in commands shall be minimized. [Source: MIL-HDBK-761A, 5.1.5.3.a]

- **8.9.2.19 Use of delimiter.** When a delimiter is needed, one delimiter, such as the slash (/), shall be used throughout an application and related applications. [Source: MIL-HDBK-761A, 5.1.5.3.a]

- **8.9.2.20 Blank spaces.** Blank spaces should not be used or interpreted by an application. [Source: MIL-HDBK-761A, 5.1.5.3.b]

- **8.9.2.21 Editing commands.** Users shall be able to edit textual commands, after they are typed but before they are executed, using standard editing techniques. [Source: MIL-HDBK-761A, 5.1.5.b]

- **8.9.2.22 Execution.** Once a textual command has been composed, an explicit enter or execute action by the user shall be required. [Source: MIL-HDBK-761A, 5.1.5.a]

- **8.9.2.23 Confirmation of a command.** When the execution of a command might result in a delay, the deletion or modification of data, or other potentially adverse consequences, the system or application shall inform the user of the nature of the consequence and request that the user confirm the command unless an **UNDO** command is available. [Source: MIL-HDBK-761A, 5.1.5.d]

- **8.9.2.24 Unrecognized commands.** When the system or application does not recognize a command a user has entered, the system or application shall inform the user and request the user to revise or replace the command. [Source: MIL-HDBK-761A, 5.1.5.c]

8.9.3 Queries

8.9.3.1 General

- ▫ **8.9.3.1.1 When to use.** Query language should be used for tasks emphasizing unpredictable information retrieval and with moderately trained users. [Source: MIL-HDBK-761A, 5.1.1.13]

  Definitions. A **database** is a set of interrelated data stored in a computer. A **query** is the process of specifying, locating, and retrieving data matching specified characteristics from a database.

- ▫ **8.9.3.1.2 Ease of use.** A query language should be easy to learn and use. [Source: DOE HFDG ATCCS, V2.0, 13.1.1, 13.1.5]

- ▫ **8.9.3.1.3 Interactive.** A query language should permit on-line, interactive use as opposed to batch or off-line use. [Source: DOE HFDG ATCCS, V2.0, 13.1.2]

- ▪ **8.9.3.1.4 Organization of data.** A query language shall be designed so that it considers the structure or organization of the data as perceived by the user group. [Source: MIL-HDBK-761A, 5.1.6.1.b; MIL-STD-1801, 4.2.1.6.a]

- ▪ **8.9.3.1.5 Task-oriented queries.** A user shall be able to specify which data are requested without having to tell the system how to find the data. [Source: MIL-HDBK-761A, 5.1.6.1.b; MIL-STD-1801, 4.2.1.6.a]

- ▫ **8.9.3.1.6 User assistance.** A query language should assist users in the construction of complex queries and in narrowing down overly broad queries. [Source: DOE HFDG ATCCS, V2.0, 13.1.3]

- ▪ **8.9.3.1.7 Large-scale retrieval confirmation.** When a query will result in a large or time-consuming data retrieval, the user shall be notified of the amount of data or time and request that the user confirm the transaction or take further action to narrow the query before proceeding. [Source: MIL-HDBK-761A, 5.1.6.2.a; MIL-STD-1801, 4.2.1.6.f]

- ▪ **8.9.3.1.8 Retrieval interrupt.** The user shall be able to interrupt the retrieval process. [Source: MIL-HDBK-761A, 5.1.6.2.a; MIL-STD-1801, 4.2.1.6.f]

- ▫ **8.9.3.1.9 Logical combination queries.** A query language should permit the use of logical combinations in the formation of a query. [Source: MIL-HDBK-761A, 5.1.6.2.b]

  Example. Combinations that might be permitted include "and," "or," and "not." [Source: MIL-HDBK-761A, 5.1.6.2.b]

- **8.9.3.1.10 Subsequent queries.** A query language should permit the linking of sequential queries so that subsequent queries can be based on the results of prior queries. [Source: MIL-HDBK-761A, 5.1.6.2.c]

  Example. An example might be: "Of those records retrieved, how many...?" [Source: MIL-HDBK-761A, 5.1.6.2.c]

- **8.9.3.1.11 Flexible queries.** When natural language query is permitted, the system or application shall allow users to employ alternative forms when initiating queries. [Source: MIL-HDBK-761A, 5.1.6.1.c; MIL-STD-1801, 4.2.1.6.d]

  Example. A system might accept all of the following as equivalent:

  Update network display within 3 miles.
  Update network display in a 3-mile radius.
  Update network display out to 3 miles.

- **8.9.3.1.12 Error detection and correction.** A query language should detect and notify users of syntax errors in queries and assist them in correcting the errors. [Source: DOE HFDG ATCCS, V2.0, 13.1.4]

- **8.9.3.1.13 Spelling and word variants.** A query language should recognize spelling variations (e.g., gray and grey), acronyms, inverted word order (e.g., television monitor and monitor, television), and truncations. [Source: DOE HFDG ATCCS, V2.0, 13.3.2, 13.3.3.4]

- **8.9.3.1.14 Formats matched to user needs.** Query and display formats should be matched to the nature of the searches users will make. [Source: DOE HFDG ATCCS, V2.0, 13.1.7]

- **8.9.3.1.15 Number of formats.** When appropriate, more than one format should be provided for queries and displays. [Source: DOE HFDG ATCCS, V2.0, 13.1.7]

- **8.9.3.1.16 User preferences.** To the extent practicable, users should be able to choose the type of format (pictorial, verbal, or tabular) they prefer for queries and displays. [Source: DOE HFDG ATCCS, V2.0, 13.1.9]

- **8.9.3.1.17 Importance of search terms.** A query language should permit users to rank order the search terms in importance and use this ranking in displaying the retrieved information**.** [Source: DOE HFDG ATCCS, V2.0, 13.3.1.2]

- **8.9.3.1.18 Redisplay.** A query language should retain the results of the previous search so that they can be redisplayed without repeating the search. [Source: DOE HFDG ATCCS, V2.0, 13.3.1.4]

- **8.9.3.1.19 Punctuation.** A query language should automatically remove or ignore punctuation in search terms. [Source: DOE HFDG ATCCS, V2.0, 13.3.2.5]

- **8.9.3.1.20 Word roots.** A query language should include a means for reducing words to their root forms, for example, by removing suffixes and searching for the roots. [Source: DOE HFDG ATCCS, V2.0, 13.3.3.1, 13.3.3.2]

- **8.9.3.1.21 Exceptions.** A query language should provide for a list of exceptional words that are accepted literally, that is, that are not reduced to their roots. [Source: DOE HFDG ATCCS, V2.0, 13.3.3.3]

- **8.9.3.1.22 Appearance of output.** The appearance, print format, and organization of the output should be natural and acceptable to the users. [Source: DOE HFDG ATCCS, V2.0, 13.3.5.2]

- **8.9.3.1.23 User-specified output.** Users should be able to specify report formats. [Source: DOE HFDG ATCCS, V2.0, 13.3.5.2]

- **8.9.3.1.24 Command clarity.** Commands should be clear, unambiguous, and distinctive. [Source: DOE HFDG ATCCS, V2.0, 13.4.1.2, 13.4.1.3]

- **8.9.3.1.25 Minimal user effort.** The number of keystrokes required of users should be minimized. [Source: DOE HFDG ATCCS, V2.0, 13.4.1.4]

- **8.9.3.1.26 Reuse of queries.** A query language should permit reuse of frequent queries. [Source: DOE HFDG ATCCS, V2.0, 13.4.5]

- **8.9.3.1.27 User definition of macros**. A query language should allow the user to define macros. [Source: DOE HFDG ATCCS, V2.0, 13.4.5]

- **8.9.3.1.28 Keyboard accelerators**. A query language should incorporate keyboard accelerators. [Source: DOE HFDG ATCCS, V2.0, 13.4.5]

- **8.9.3.1.29 Automatic periodic backup.** A query language should automatically back up data periodically when specified by the user. [Source: DOE HFDG ATCCS, V2.0, 13.4.5]

- **8.9.3.1.30 Restore.** A query language should have a **Restore** utility to recover backup data. [Source: DOE HFDG ATCCS, V2.0, 13.4.5]

- **8.9.3.1.31 Pause and Resume.** A query language should have a **Pause** and **Resume** capability that would allow a user to stop working with the query language and resume at a later time. [Source: DOE HFDG ATCCS, V2.0, 13.4.5]

8.9.3.2 Query screen design

- **8.9.3.2.1 Relevant information only.** Query screens should include only information that is relevant to the task, that is, information necessary to perform actions, make decisions, or answer questions. [Source: DOE HFDG ATCCS, V2.0, 13.2.1.1]

- **8.9.3.2.2 Frequently used information.** The most frequently used information should be located in the upper left portion of a screen and, if multiple screens are involved, on the first screen or screens. [Source: DOE HFDG ATCCS, V2.0, 13.2.1.3, 13.2.2.1]

8.9.3.3 Searching

- **8.9.3.3.1 Searching operations.** A query language should provide the following searching operations to users.

  These include

  a. a **Select** operation that enables users to select the desired data-base;

  b. **Create** and **Erase** operations that enable users to create and erase data sets;

  c. a **Combine** operation that enables users to combine data sets;

  d. a **Report** operation that enables users to format, name, specify, display, print, and save a query;

  e. a **Restrict** operation that enables users to restrict the output of a retrieval set;

  f. a **Save** operation that enables users to save the results of a search; and

  g. a **Search history** operation that enables users to view a list of previous search commands upon request. [Source: DOE HFDG ATCCS, V2.0, 13.5.1]

- **8.9.3.3.2 Control operations.** A query language should provide control operations to users. These include

  a. a **Mark** operation that stores the current field value for future reference (e.g., marking a field or record for deletion),

  b. a **Describe** operation that enables users to receive a detailed explanation or description of the current field value,

  c. a **Drop** operation that drops the current field from the structure, and

  d. a **Status** operation that enables users to request status information. [Source: DOE HFDG ATCCS, V2.0, 13.5.2]

- **8.9.3.3.3 Query formulation operations.** A query language should provide query formulation operations. These include

  a. a **Select** operation that identifies the fields from tables and functions that will appear in the query results,

  b. a **Compile** operation that generates and validates an executable operation,

  c. a **Run** or **Do query** operation that causes execution of the query,

  d. a **Show** operation that allows various presentations of a tabular result and that could be used to present a preview of the results of a query or report,

  e. a **Modify** operation that allows users to make changes in the definition of an existing query or report, and

  f. a **Save** operation that allows storage and repeated use or modification of a query. [Source: DOE HFDG ATCCS, V2.0, 13.5.4]

- **8.9.3.3.4 Recognizing abbreviations.** A query language should recognize both the abbreviated and the unabbreviated term. [Source: DOE HFDG ATCCS, V2.0, 13.5.5.1]

- **8.9.3.3.5 Search time feedback.** A query language should inform users if a search will take more than a short time to complete. [Source: DOE HFDG ATCCS, V2.0, 13.5.5.3]

- **8.9.3.3.6 Prompting the user.** When a search will take more than a short time to complete or will overload the computer, a query language should prompt the user to confirm, modify, or terminate the search. [Source: DOE HFDG ATCCS, V2.0, 13.5.5.3]

- **8.9.3.3.7 Additional operations.** A query language should provide additional operations. These include

  a. a **Browse** operation that enables users to navigate through a data-base;

  b. a **Report format** operation that enables users to format the results of queries as reports;

  c. a **Search index** operation that enables users to view the list of words and phrases available for searching, including a link to a data-base thesaurus to suggest additional search terms;

  d. a **Proximity searching** operation that enables users to search for words or terms in a positional relationship with word index fields (e.g., titles or abstracts);

  e. a logical search operation using the logical operators and, or, and not;

  f. an iterative operation that enables users to define a search, view the results, and re-refine the search as many times as necessary;

  g. an operation to specify a range of values for searching;

  h. an operation to specify fields for searching;

  i. an operation to specify field values for searching,

  j. an operation to order field values (e.g., numerically or alphabetically); and

  k. an operation to search across files that enables users to obtain the number of references including the search term in all potential databases. [Source: DOE HFDG ATCCS, V2.0, 13.5.6]

8.9.3.4 Multiple levels

- **8.9.3.4.1 Accommodating users differing in experience.** A query language should accommodate users with different levels of experience. [Source: DOE HFDG ATCCS, V2.0, 13.6.1]

- **8.9.3.4.2 Changing levels.** Users should be able to change the level at which they interact with the language at any time during a session. [Source: DOE HFDG ATCCS, V2.0, 13.6.1.1]

- **8.9.3.4.3 Context-sensitive help.** Context-sensitive help should be available upon user request at all levels. [Source: DOE HFDG ATCCS, V2.0, 13.6.1.3]

8.9.3.5 Novice and expert users

- **8.9.3.5.1 Novice level.** At the novice level, a query language should enable a user to begin work with little or no training. [Source: DOE HFDG ATCCS, V2.0, 13.6.2, 13.6.2.1]

  Discussion. A novice interface may contain only a subset of the search capabilities and fewer searchable fields, with the result that it may not attain the same specificity or variety of search techniques. [Source: DOE HFDG ATCCS, V2.0, 13.6.2, 13.6.2.1]

- **8.9.3.5.2 Prompting novices.** At the novice level, a query language should prompt users to select options from lists and should provide explanations of the options. [Source: DOE HFDG ATCCS, V2.0, 13.6.2.2]

- **8.9.3.5.3 Commands for novices.** The command set for novices should be fewer and simpler than the command set for experts. [Source: DOE HFDG ATCCS, V2.0, 13.6.2.3]

- **8.9.3.5.4 Experienced users.** When the normal user guidance techniques provided might slow experienced users, alternative modes should also be provided that allow the bypassing of these normal techniques. [Source: MIL-HDBK-761A, 5.4.1.1.b]

- **8.9.3.5.5 Commands for experts.** A query language for experts should allow the expert users to enter more than one command at a time. [Source: DOE HFDG ATCCS, V2.0, 13.6.3.2]

8.10 User-initiated interrupts

8.10.1 General

- **8.10.1.1 User interruption of transactions.** A system or application shall permit a user to interrupt or terminate the current transaction. [Source: DOE HFDG ATCCS, V2.0, 2.4.5, 2.4.10; MIL-HDBK-761A, 5.1.1.4.3.d, 5.1.9; MIL-STD- 1801, 4.2.3.1]

- **8.10.1.2 Distinct interrupts.** Each type of interrupt shall have a separate control option and a distinct name. [Source: DOE HFDG ATCCS, V2.0, 2.4.5, 2.4.10; MIL-HDBK-761A, 5.1.1.4.3.d, 5.1.9; MIL-STD-1801, 4.2.3.1]

  Example. The following types of interrupts may be provided: **Cancel, Escape, Back, Restart, Abort, Stop, Pause-Continue,** and **Suspend.** [Source: DOE HFDG ATCCS, V2.0, 2.4.5, 2.4.10; MIL-HDBK-761A, 5.1.1.4.3.d, 5.1.9; MIL-STD- 1801, 4.2.3.1]

- **8.10.1.3 Stored or entered data.** User interruptions shall not change or remove stored or entered data, with the exception of the **Cancel** interrupt. [Source: MIL-HDBK-761A, 5.1.9.b]

- **8.10.1.4 Back (or Go-back).** A nondestructive **Back** or **Go-back** option shall be provided to return the display to the last previous transaction. [Source: DOE HFDG ATCCS, V2.0, 2.4.11; MIL-HDBK-761A, 5.1.9.c.2; MIL-STD-1801, 4.2.3.1.b]

- **8.10.1.5 Cancel (or Undo).** When appropriate, a system or application shall provide a **Cancel** or **Undo** option that will erase changes just made by a user and restore the current display to its previous state. [Source: DOE HFDG ATCCS, V2.0, 2.4.9; MIL-HDBK-761A, 5.1.9.c.1; MIL-STD-1801, 4.2.3.1.a]

- **8.10.1.6 Undo.** The **Undo** command shall be used to reverse the effect of the user's previous operation. [Source: Apple Computer Inc., 1992 – p. 113]

- **8.10.1.7 Reversing Undo.** The user shall be able to reverse the effect of the last **Undo** command either by selecting the **Undo** command a second time or selecting a **Redo** command. [Source: Apple Computer Inc., 1992 – p. 113]

- **8.10.1.8 End, Exit, or Stop.** When appropriate, a system or application shall provide an **End, Exit,** or **Stop** option to conclude a repetitive transaction sequence. [Source: DOE HFDG ATCCS, V2.0, 2.4.4; MIL-HDBK-761A, 5.1.9.c.5; MIL-STD-1801, 4.2.3.1.e]

- **8.10.1.9 Pause and Continue.** When appropriate, a system or application shall provide **Pause** and **Continue** options that will interrupt and later resume, respectively, a transaction sequence without any change to data entries or control logic for the interrupted transaction. [Source: DOE HFDG ATCCS, V2.0, 2.4.2; MIL-HDBK-761A, 5.1.9.c.6; MIL-STD-1801, 4.2.3.1.f]

- **8.10.1.10 Indicating pause status.** When a **Pause** option is provided and selected, the system or application shall provide an indication that the transaction sequence has been halted. [Source: DOE HFDG ATCCS, V2.0, 2.4.3; MIL-HDBK-761A, 5.1.9.c.6]

- **8.10.1.11 Resuming paused interactions.** The system or application shall prompt the user to select **Continue** to resume the interrupted sequence. [Source: DOE HFDG ATCCS, V2.0, 2.4.3; MIL-HDBK-761A, 5.1.9.c.6]

- **8.10.1.12 Restart (or Revert).** When appropriate, a system or application shall provide a **Restart** (or **Revert**) option that will cancel entries made in a defined transaction sequence and will return the user to the beginning of the sequence. [Source: DOE HFDG ATCCS, V2.0, 2.4.12; MIL-HDBK-761A, 5.1.9.c.4;MIL-STD-1801,4.2.3.1.c]

- **8.10.1.13 Confirming Restart interactions.** When a **Restart** will result in the loss of data or changes, the system shall require a confirming action by the user. [Source: DOE HFDG ATCCS, V2.0, 2.4.12; MIL-HDBK-761A, 5.1.9.c.4; MIL-STD-1801,4.2.3.1.c]

- **8.10.1.14 Review.** When appropriate, a system or application shall provide a nondestructive **Review** option that will return to the first display in a defined transaction sequence, permitting the user to review a sequence of entries and make necessary changes. [Source: DOE HFDG ATCCS, V2.0, 2.4.1; MIL-HDBK-761A, 5.1.9.c.3]

- **8.10.1.15 Suspend.** When appropriate, a system or application shall provide a **Suspend** option that permits a user to preserve the current state of a transaction while leaving the system and to resume the transaction at a later time. [Source: DOE HFDG ATCCS, V2.0, 2.4.7.1; MIL-HDBK-761A, 5.1.9.c.7; MIL-STD-1801, 4.2.3.1.g]

- **8.10.1.16 Indicating suspended status.** When a system or application provides a **Suspend** option, it shall display an indication that a transaction has been suspended whenever the option has been selected. [Source: DOE HFDG ATCCS, V2.0, 2.4.7.2; MIL-HDBK-761A, 5.1.9.c.7]

- **8.10.1.17 Resuming suspended transactions.** The system shall prompt the user with information on how to resume the suspended transaction at his or her next log on. [Source: DOE HFDG ATCCS, V2.0, 2.4.7.2; MIL-HDBK-761A, 5.1.9.c.7]

  Example. The user might see: "Type **Exit** to return to application." [Source: DOE HFDG ATCCS, V2.0, 2.4.7.2; MIL-HDBK-761A, 5.1.9.c.7]

8.10.2 Freeze frame

- **8.10.2.1. Freezing changing data.** Applications in which displayed data are changed automatically should allow users to freeze the display temporarily. [Source: MIL-HDBK-761A, 5.3.2.4.2.a]

- **8.10.2.2 Labeling a frozen display.** When a display is frozen, its frozen status shall be clearly indicated. [Source: MIL-HDBK-761A, 5.3.2.4.2.b]

- **8.10.2.3 Notification of changes while display is frozen.** Users should be notified of any significant changes that occur while a display is frozen. [Source: MIL-HDBK-761A, 5.3.2.4.2.b]

- **8.10.2.4 Unfreezing a display.** Unless specified otherwise by the user, when a frozen display is released from its frozen state, it shall indicate conditions at the time of release, not the time it was frozen. [Source: MIL-HDBK-761A, 5.3.2.4.2.c]

8.11 File management functions

8.11.1 General

- ▪ **8.11.1.1 Saving and retrieving graphic data.** An easy means shall be provided for saving and retrieving data. [Source: MIL-HDBK-761A, 5.2.6.b]

- ▪ **8.11.1.2 Stored files.** Users shall be able to specify names for storing text or graphic data files and be able to view lists of these stored files. [Source: MIL-HDBK-761A, 5.2.6.b]

- ▫ **8.11.1.3 Saving to a data file.** The user should be able to save the information entered into a file by a single action that will permit the user to continue interacting with the file. [Source: Nuclear Regulatory Commission, 1996 - 2.6.2-1]

- ▪ **8.11.1.4 Protection against exiting a file without saving.** The user shall be prompted to save the file contents when exiting a file. [Source: Nuclear Regulatory Commission, 1996 - 2.6.2-5]

- ▫ **8.11.1.5 Recovery of file.** Information from a file that has been modified and stored with the "save" action should be retrievable with a single action. [Source: Nuclear Regulatory Commission, 1996 - 2.6.2-6]

- ▫ **8.11.1.6 Automatic saving of a file.** The system should provide the capability to automatically save a file at frequent intervals during the editing process. [Source: Nuclear Regulatory Commission, 1996 - 2.6.2-7]

- ▫ **8.11.1.7 Automatic backup.** Users should have the option of invoking an automatic backup function that retains previous versions of files. [Source: Nuclear Regulatory Commission, 1996 - 2.6.2-8]

8.11.2 Clipboard

- ▫ **8.11.2.1 Automatic placement of cut data in buffer.** When selected data are cut or copied from a text file, tabular file, and/or graphics file and placed in a temporary editing buffer, the data should be placed in the buffer automatically with the only specific action required by the user being the cut or copy action. [Source: Nuclear Regulatory Commission, 1996 - 2.6.3-1]

- ▫ **8.11.2.2 Contents of temporary buffer.** The contents of the temporary buffer should remain intact after the application from which the contents were taken is closed. [Source: Nuclear Regulatory Commission, 1996 - 2.6.3-2]

- ▫ **8.11.2.3 Default condition of buffer.** The default condition should be that additions to the temporary editing buffer are not cumulative. [Source: Nuclear Regulatory Commission, 1996 - 2.6.3-3]

- **8.11.2.4 Access to contents of temporary buffer.** The user should be able to access the contents of the temporary editing buffer in a window with a single action. [Source: Nuclear Regulatory Commission, 1996 - 2.6.3-4]

- **8.11.2.5 Clipboard.** The clipboard shall be used to transfer data among compatible applications and desk accessories. [Source: Apple Computer Inc., 1992 – p. 111]

- **8.11.2.6 Showing clipboard contents.** The application shall show the contents of the clipboard in a window. [Source: Apple Computer Inc., 1992 – p. 111]

- **8.11.2.7 Viewable contents.** The contents of the clipboard shall be viewable but not editable while they are on the clipboard. [Source: Apple Computer Inc., 1992 – p. 111]

8.11.3 File management commands

- **8.11.3.1 New.** A **NEW** command should be provided to allow the user to open a new file. [Source: HFDG, 1996 - Appendix C.1]

- **8.11.3.2 Open.** An **OPEN** command should be provided to open an existing file. [Source: HFDG, 1996 - Appendix C.1]

- **8.11.3.3 Print.** The user should be able to initiate a process for printing the contents of a file. [Source: HFDG, 1996 - Appendix C.1]

- **8.11.3.4 Restore.** The user should be able to retrieve the backup copy of a file and save it to a storage device. [Source: HFDG, 1996 - Appendix C.2]

- **8.11.3.5 Revert.** A **REVERT** command should be provided allowing the user to replace the current file with the version that was most recently saved. [Source: HFDG, 1996 - Appendix C.2]

- **8.11.3.6 Save.** A **SAVE** command should be provided allowing the user to save a file to a storage device under the same file name and prompt the user to provide a name if the file does not have one. [Source: HFDG, 1996 - Appendix C.2]

- **8.11.3.7 Save as.** A **SAVE AS** command should be provided allowing the user to save a copy of a file under a new name and prompt the user for the new name. [Source: HFDG, 1996 - Appendix C.2]

- **8.11.3.8 Copy.** The user should have the ability to create a copy of a file. [Source: HFDG, 1996 - Appendix C.3]

- **8.11.3.9 Naming copied file.** The user should be prompted to name the copied file. [Source: HFDG, 1996 - Appendix C.2]

- **8.11.3.10 Delete.** The user should be able to delete a file from a storage device. [Source: HFDG, 1996 - Appendix C.3]

- **8.11.3.11 Confirmation of delete request.** The application should request confirmation prior to deletion of the file. [Source: Apple Computer Inc., 1992 – p. 10]

- **8.11.3.12 Archive.** The user should be given the ability to create a backup copy of a file. [Source: HFDG, 1996 - Appendix C.2]

- **8.11.3.13 Close.** The user should be able to close a file. [Source: HFDG, 1996 - Appendix C.2]

- **8.11.3.14 Confirmation of close request.** The application should request confirmation when there are unsaved changes that have been made to the file that is being closed and allow the user to save the changes. [Source: Apple Computer Inc., 1992 – p. 10]

8.12 Selection methods

8.12.1 Selection options

- **8.12.1.1 Selecting data.** Applications should provide a means for the user to select data. [Source: Microsoft Corp., 1992 - 3.1]

- **8.12.1.2 Selecting single or multiple items.** Users should be able to select single or multiple items. [Source: Microsoft Corp., 1992 - 3.1.1.2]

8.12.2 Highlighting

- **8.12.2.1 Highlighting to indicate selections.** When text is selected, it should appear highlighted. [Source: Microsoft Corp., 1992 - 3.1.1.1]

  Discussion. The appearance of highlighted text will vary according to system specifications and the type of display used. [Source: Microsoft Corp., 1992 - 3.1.1.1]

- **8.12.2.2 Highlighting on monochrome displays.** Reverse video should be used to indicate selected data on monochrome displays. [Source: Microsoft Corp., 1992 - 3.1.1.1]

- **8.12.2.3 Highlighting on gray-scale displays.** The selection should be marked with a shade of gray on gray-scale displays. [Source: Microsoft Corp., 1992 - 3.1.1.1]

- **8.12.2.4 Highlighting on color displays.** A highlight color should be used on color displays. [Source: Microsoft Corp., 1992 - 3.1.1.1]

- **8.12.2.5 Highlighting graphics.** Graphics should be highlighted in the same way as text by the addition of rectangles with resizing handles or by a combination thereof. [Source: Microsoft Corp., 1992 - 3.1.1.1]

- **8.12.2.6 Highlighting text in dialog boxes.** The same methods used in data windows should be used to highlight text in dialog boxes. [Source: Microsoft Corp., 1992 - 3.1.1.1]

- **8.12.2.7 Highlighting toolboxes and 3D buttons.** For 3D buttons such as toolboxes, the depressed button graphic should be used to indicate selection. [Source: Microsoft Corp., 1992 - 3.1.1.1]

- **8.12.2.8 Highlighting value set controls.** An outline frame in the highlight color should surround the chosen value for value set controls that do not contain 3D buttons. [Source: Microsoft Corp., 1992 - 3.1.1.1]

- **8.12.2.9 Highlighting critical information.** Critical information in user guidance shall be highlighted using the same methods used to highlight critical information in other types of data display. [Source: MIL-HDBK-761A, 5.4.1.2.b]

- **8.12.2.10 Leaving selections highlighted.** A selection should remain highlighted in an inactive window only when it is useful to the user. [Source: Microsoft Corp., 1992 - 3.1.1.1]

- **8.12.2.11 Active end of selection.** The active end of the selection shall be the end opposite the anchor point. [Source: Microsoft Corp., 1992 - 3.1.1.3]

- **8.12.2.12 Extending a selection.** The user shall extend the selection by moving the active end away from the anchor point. [Source: Microsoft Corp., 1992 - 3.1.1.3]

- **8.12.2.13 Shortening selections.** The user shall shorten the selection by moving the active end toward the anchor point. [Source: Microsoft Corp., 1992 - 3.1.1.3]

- **8.12.2.14 Insertion point.** The selection shall serve as an insertion point when the active end reaches the anchor point. [Source: Microsoft Corp., 1992 - 3.1.1.3]

- **8.12.2.15 Direction of extending selections.** The user shall be able to extend a selection in either direction from the insertion point but not in both directions simultaneously. [Source: Microsoft Corp., 1992 - 3.1.1.3]

- **8.12.2.16 De-selection method.** Currently selected items should be deselected if the user clicks on new data. [Source: Microsoft Corp., 1992 - 3.1.1.4]

- **8.12.2.17 De-selection and data.** Deselecting shall not delete the data. [Source: Microsoft Corp., 1992 - 3.1.1.4]

- **8.12.2.18 Deselecting groups of data**. Items in multiple (contiguous or disjoint) selections should be able to be deselected by the user singularly or as a group. [Source: Microsoft Corp., 1992 - 3.1.1.3]

- **8.12.2.19 Margin selection in text arrays.** In text arrays displayed in windows, users should be able to select lines, paragraphs, or entire documents by clicking in the left margin area between the left window frame and the left edge of the text. [Source: Microsoft Corp., 1992 - 3.1.2.3]

  Discussion. Margin selection is a convenient way to select large sections of data with a single click. In text, margin selection should be used to select lines, paragraphs, or entire documents. In data arrays, it should be used to select rows and columns. [Source: Microsoft Corp., 1992 - 3.1.2.3]

- **8.12.2.20 Margin selection in data arrays.** Users should be able to select columns and rows in data arrays by clicking on the row and column labels. [Source: Microsoft Corp., 1992 - 3.1.2.3]

- **8.12.2.21 Using outline selection for graphical objects.** The user should be able to use **outline selection** to drag an outline around an object, a set of objects, or a portion of an object while holding down a mouse button. [Source: Microsoft Corp., 1992 - 3.1.2.4]

- **8.12.2.22 Items selected with outline selection.** When the mouse button is released, all objects falling completely within the outline shall be selected and preexisting selections removed. [Source: Microsoft Corp., 1992 - 3.1.2.4]

  Definition. Outline selection is an extended form of drag selection that is particularly useful for graphical objects when normal drag selection conflicts with moving objects with the mouse. [Source: Microsoft Corp., 1992 - 3.1.2.4]

- **8.12.2.23 Outline selection of bitmaps.** When outline selection is used for bitmaps, only the parts of the bitmap falling within the outline shall be selected. [Source: Microsoft Corp., 1992 - 3.1.2.4]

- **8.12.2.24 Keyboard selection.** Keyboard selection should indicate the data that will be affected by any action the user initiates. [Source: Microsoft Corp., 1992 - 3.1.3]

- **8.12.2.25 Keyboard techniques for continuous selection.** In text-based applications, the user should be able to select a single insertion point with the keyboard by navigating to the desired location, which then becomes the new anchor point. [Source: Microsoft Corp., 1992 - 3.1.3.1]

- **8.12.2.26 Selecting a range of characters in a text display.** A user should be able to select a range of characters in a text display using the **SHIFT** key in conjunction with navigation keys. [Source: Microsoft Corp., 1992 - 3.1.3.1]

  Definition/discussion. Several keys such as **Home, End, Page Up, Page Down**, and the arrow keys are dedicated to keyboard navigation and thereby are called the **navigation keys**. By holding down the **SHIFT** key while pressing any navigation key (e.g., **Home, End, Page Up, Page Down**, or an arrow key), the cursor moves to the location implied by the navigation key, and all characters between the anchor point and the destination are selected. The anchor point does not move. Unlike mouse navigation, keyboard navigation changes the selection unless **Scroll Lock** mode is in effect. [Source: Microsoft Corp., 1992 - 3.1.3.1]

- **8.12.2.27 Selection methods.** There are various selection techniques that should be used.

  a. **Selection by clicking –** To select by clicking, the user positions the pointer over the desired item and clicks the mouse button. A click refers to pressing and releasing a particular button on the mouse input device. Depending on the software and platform being used, selection may require a single or a double click.

  b. **Selection by dragging –** To select by dragging, the user drags the cursor over a range of items while holding down the mouse button.

  c. **Changing a selection with command-click -** To make discontinuous selection in a text or array application, the user selects the first item in the usual manner and holds down the command key while selecting the remaining items. [Source: Apple Computer Inc., 1992 – pp. 288-290]

  Discussion. Each item is selected in the same manner as if it were the whole selection but, because the command key is held down, the new items are added to the existing selection instead of replacing it. If one of the pieces selected with command-click is already within an existing part of the selection, the item is removed from the selection. [Source: Apple Computer Inc., 1992 – pp. 288-290]

8.13 Transaction options

8.13.1 General

- **8.13.1.1 User-specified transaction timing.** When appropriate to task requirements, users shall be able to specify transaction timing. [Source: DOE HFDG ATCCS, V2.0, 2.3.3; MIL-HDBK-761A, 5.1.1.4.1;MIL-STD-1801,4.2.2.4]

  Example. Users might be able to specify when a transaction starts, when it is completed, and the periodic scheduling of repeated transactions. [Source: DOE HFDG ATCCS, V2.0, 2.3.3; MIL-HDBK-761A, 5.1.1.4.1;MIL-STD-1801,4.2.2.4]

- **8.13.1.2 User-memory load.** The number of mnemonics, codes, special or long sequences, and special instructions that users may need to learn shall be minimized. [Source: MIL-HDBK-761A, 5.1.1.4.3.e]

- **8.13.1.3 Number of characters for codes.** When the user must recall alphanumeric codes, the codes shall be limited to five characters. [Source: CTA, 1996 - 4.2.5.2]

- **8.13.1.4 Control entries distinguishable from text.** Control entries that are displayed in text (e.g., paragraph indentation symbols and printer commands such as begin and end underline) should be distinguishable from the main text. [Source: MIL-HDBK-761A, 5.2.3.3.g]

- **8.13.1.5 Prompting control entries.** The system or application shall provide the user whatever information is required to guide control entries. [Source: DOE HFDG ATCCS, V2.0, 2.3.8; MIL-HDBK-761A, 5.1.1.4.2.f]

  Examples. Prompts may be incorporated into a display at any point in a transaction sequence that will be helpful, or prompts may appear in response to a request for help. [Source: DOE HFDG ATCCS, V2.0, 2.3.8; MIL-HDBK-761A, 5.1.1.4.2.f]

- **8.13.1.6 Consistent control prompting.** When prompts are used to guide the user in making control entries, the selected prompts shall be used consistently. [Source: DOE HFDG ATCCS, V2.0, 2.3.8; MIL-HDBK-761A, 5.1.1.4.2.f]

- **8.13.1.7 List of basic control options.** A list of basic control options that are always available to a user shall be easily displayable. [Source: DOE HFDG ATCCS, V2.0, 2.3.9; MIL-HDBK-761A, 5.1.1.4.2.a]

  Discussion. This list can serve as a "home base" or starting point for control entries. An example is the system-level menu. [Source: DOE HFDG ATCCS, V2.0, 2.3.9; MIL-HDBK-761A, 5.1.1.4.2.a]

- **8.13.1.8 Appropriate specific options.** A list of the control options that are specifically appropriate for a particular transaction should be displayed in the working display or by user command. [Source: MIL-HDBK-761A, 5.1.1.4.2.c]

- **8.13.1.9 Option wording.** The wording of control options should be task oriented, reflecting a user's view of the current transaction. [Source: MIL-HDBK-761A, 5.1.1.4.3.a]

  Example. When users use the term "assign," the control option should also be **Assign**. [Source: MIL-HDBK-761A, 5.1.1.4.3.a]

- **8.13.1.10 Option presentation.** The items presented in a list of basic options should be grouped, labeled, and ordered according to logical function, sequence, frequency, or criticality of use**.** [Source: MIL-HDBK-761A, 5.1.1.4.2.b]

- **8.13.1.11 Option code display.** When users must select options by entering codes, the code associated with each option shall be displayed in a consistent manner and shall be distinct from other codes. [Source: DOE HFDG ATCCS, V2.0, 2.5.8]

- **8.13.1.12 Displaying control defaults.** When control is accomplished by keyed command or option code entries and a default entry is defined, the default shall be displayed to the user. [Source: DOE HFDG ATCCS, V2.0, 2.3.2; MIL-HDBK-761A, 5.1.1.4.3.b]

- **8.13.1.13 Initial cursor position for pointing devices.** When a user must select among displayed options using a pointing device, the cursor shall be placed on the default option when the display appears. [Source: DOE HFDG ATCCS, V2.0, 2.3.7.2]

  Definition. A **cursor** is a marker on the display screen that indicates the position where the computer expects the next input or will display the next output. The cursor may be positioned by the computer or by the user. [Source: DOE HFDG ATCCS, V2.0, 2.3.7.2]

- **8.13.1.14 Initial cursor position for keyboards.** When a user must select among displayed options using a keyboard, the cursor shall be placed on the default option in the control entry area (with that control entry area having implicit input focus) when the display appears. [Source: DOE HFDG ATCCS, V2.0, 2.3.7.1]

- **8.13.1.15 Consistent continue option.** At any step in a defined sequence of transactions, if there is only a single appropriate next step, the system or application shall provide a consistent control option. [Source: DOE HFDG ATCCS, V2.0, 2.3.1; MIL-HDBK-761A, 5.1.1.4.3.c]

- **8.13.1.16 Control option for signaling data entry.** When data entry is involved, an explicit **Enter** or **Tab** control option signaling entry shall be used rather than a **Continue** or **Next** action. [Source: DOE HFDG ATCCS, V2.0, 2.3.1; MIL-HDBK-761A, 5.1.1.4.3.c]

- **8.13.1.17 Dead-end transactions.** A transaction should never leave a user without further available options. [Source: MIL-HDBK-761A, 5.1.1.4.2.e]

- **8.13.1.18 Options at completion of a transaction.** A transaction should provide next steps or alternatives (e.g., **Continue, Abort,** or **Go to main directory**) at the end of a transaction. [Source: MIL-HDBK-761A, 5.1.1.4.2.e]

8.13.2 Stacked commands

- **8.13.2.1 Command stacking.** A system or application should permit but not require a user to enter a sequence (or stack) of command names, abbreviations, and option codes as a single stacked command. [Source: DOE HFDG ATCCS, V2.0, 2.3.6, 2.3.6.3, 2.1.14.3; MIL-HDBK-761A, 5.1.1.4.4.b; MIL-STD-1801, 4.2.2.2]

  Example. A stack of commands might execute a complete task. [Source: DOE HFDG ATCCS, V2.0, 2.3.6, 2.3.6.3, 2.1.14.3; MIL-HDBK-761A, 5.1.1.4.4.b; MIL-STD-1801, 4.2.2.2]

- **8.13.2.2 Entering stacked commands.** Stacked commands shall be entered in the same order that would be used if they were entered singly. [Source: DOE HFDG ATCCS, V2.0, 2.3.6, 2.3.6.3, 2.1.14.3; MIL-HDBK-761A, 5.1.1.4.4.b; MIL-STD-1801, 4.2.2.2]

- **8.13.2.3 Highlighting errors.** When there is an error in a stack, the system or application should highlight the point of error and prompt the user for a correct entry. [Source: DOE HFDG ATCCS, V2.0, 2.3.6, 2.3.6.3, 2.1.14.3; MIL-HDBK-761A, 5.1.1.4.4.b; MIL-STD-1801, 4.2.2.2]

- **8.13.2.4 Punctuation of stacked commands.** Required punctuation of stacked commands shall be minimized. [Source: MIL-HDBK-761A, 5.1.1.4.4.c; MIL-STD-1801, 4.2.2.2]

- **8.13.2.5 Delimiters for stacked commands.** A delimiter to separate commands shall be adopted and used consistently. [Source: MIL-HDBK-761A, 5.1.1.4.4.c; MIL-STD-1801, 4.2.2.2]

  Example. The slash (/) might be adopted as the delimiter, and a stacked command might be: **Sort/Save/Transmit.** [Source: MIL-HDBK-761A, 5.1.1.4.4.c; MIL-STD-1801, 4.2.2.2]

- **8.13.2.6 Intuitive delimiters.** The delimiter should be made as intuitive as possible by using an ampersand (&), a plus sign (+), or a comma (,). [Source: MIL-HDBK-761A, 5.1.1.4.4.c; MIL-STD-1801, 4.2.2.2]

- **8.13.2.7 User-defined stacks (macros).** A system or application should allow a user to define a series of graphical- or character-based control entries, assign the series a name (macro), and subsequently enter the series by simply entering the name of the macro. [Source: DOE HFDG ATCCS, V2.0, 2.3.6.2; MIL-HDBK-761A, 5.1.1.4.4.a; MIL-STD-1801, 4.2.2.3]

- **8.13.2.8 Index of macros.** Users should have access to their macros and programmable function keys with their respective composition of commands. [Source: Nuclear Regulatory Commission, 1996 - 2.2.4]

- **8.13.2.9 Modification of defined macros.** A user should be restricted from modifying a macro or programmable function key defined or created by a different user. [Source: Nuclear Regulatory Commission, 1996 - 2.2.4]

- **8.13.2.10 No duplication of macro names.** Users should not be able to duplicate macro names. [Source: Nuclear Regulatory Commission, 1996 - 2.2.4]

8.14 Controls

8.14.1 General

- **8.14.1.1 Consistent and distinctive.** Each type of control in an application shall be consistent and visually distinct from other types of controls. [Source: DON UISNCCS, V1.2, 6.8.1]

  Example. Push buttons are consistent and distinct from radio buttons (exclusive button sets). [Source: DON UISNCCS, V1.2, 6.8.1]

- **8.14.1.2 Distinct from other objects.** Controls shall differ in appearance from other text and graphics in an application window. [Source: DON UISNCCS, V1.2, 6.8.1]

8.14.2 Display of control options

- **8.14.2.1 Control locations and options.** Screen control locations and control options shall be clearly and appropriately indicated. [Source: MIL-HDBK-761A, 5.3.2.1.a]

- **8.14.2.2 Default values.** When the system prompts a user for a parameter that has a default value assigned, the default value shall be displayed. [Source: MIL-HDBK-761A, 5.3.2.1.b]

- **8.14.2.3 Control information.** When a control for manipulating the display becomes available, information the user needs for its use shall also be displayed. [Source: MIL-HDBK-761A, 5.3.2.1.c]

8.14.3 Icons

Icons may be used to represent operations, processes, and data structures graphically, and they may be used as a means of exercising control over system functions, components, and data structures.

- **8.14.3.1 Representative of objects.** Icons should not be used if they do not clearly represent actual physical objects. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.7.1]

- **8.14.3.2 Resolution.** Iconic representation shall not be used if display resolution is low. [Source: MIL-HDBK-761A, 5.1.8.b]

- **8.14.3.3 Description.** An icon shall consist of a graphic image and, where space permits, an identifying label. [Source: DON UISNCCS, V1.2, 4.5]

- **8.14.3.4 Icon label.** Each icon shall have a text label corresponding to the object or action, which appears adjacent to the icon shortly after the pointer focus is placed on the icon. [Source: CTA, 1996 - 3.7.4]

- **8.14.3.5 Obscuring label.** The icon designer shall not let the label obscure the icon. [Source: CTA, 1996 - 3.7.4]

- **8.14.3.6 Consistency.** Icons shall be consistent within an application and across related applications. [Source: MIL-HDBK-761A, 5.1.8.d]

- **8.14.3.7 Icon design.** To the extent possible, icons should be simple line drawings that suggest the physical object or operation they represent. [Source: MIL-HDBK-761A, 5.1.8.e]

- **8.14.3.8 Avoid humorous representations.** Humorous representations should be avoided in icons. [Source: MIL-HDBK-761A, 5.1.8.e]

- **8.14.3.9 Selecting icons.** In selecting a new icon, the user should consult standard symbol sets available from the American National Standards Institute (ANSI) and other sources to find established icons that may meet the need. [Source: CTA, 1996 - 3.7.1.5]

- **8.14.3.10 Creating icons.** When existing icons are not satisfactory, the user should create drawings that are meaningful representations to users, easily recognizable, and visually distinct from each other. [Source: CTA, 1996 - 3.7.1.6]

  Examples. Icons may be designed to represent a process or operation literally (e.g., a drawing of an aircraft), functionally (e.g., a figure representing a network), or operationally (e.g., a drawing of a pen in hand on paper). [Source: MIL-HDBK-761A, 5.1.8.e]

- **8.14.3.11 Avoid abstract icons.** Abstract icons are likely to be very difficult to learn and remember and should be avoided. [Source: CTA, 1996 - 3.7.1.3]

- **8.14.3.12 Selectable area of an icon.** Designers shall make the selectable area of an icon large enough to reduce the risk of error and increase the user's ease in selecting the icon. [Source: Ameritech Services Inc., 1996 - 4.2.5.3]

- **8.14.3.13 Minimum selectable area.** The selectable area or hotspot outside of the area of the icon shall be at least 4 millimeters. [Source: Ameritech Services Inc., 1996 - 4.2.5.3]

  Definition. The selectable area in which a user can place the pointer and successfully select an icon is often called the **hot spot**. [Source: Ameritech Services Inc., 1996 - 4.2.5.3]

- **8.14.3.14 Icon spacing.** Icons shall be positioned at least 10 millimeters apart from each other, as measured from perimeter to perimeter. [Source: Ameritech Services Inc., 1996 - 4.2.5.3]

- **8.14.3.15 Manipulation of icons.** When direct manipulation interaction is used, the system or application should use a pointing device as the primary means of manipulation. [Source: MIL-HDBK-761A, 5.2.6.a]

- **8.14.3.16 Upright orientation.** Icons and symbols should always be oriented "upright." [Source: Nuclear Regulatory Commission, 1996 - 1.3.4-7]

- **8.14.3.17 User preferences.** Users should have the option of changing the default location of icons. [Source: DON UISNCCS, V1.2, 4.5]

- **8.14.3.18 Retaining user preferences.** User-selected locations for icons should be retained across sessions. [Source: DON UISNCCS, V1.2, 4.5]

- **8.14.3.19 Moving icons.** Users should be able to move icons using similar methods available for moving windows. [Source: DON UISNCCS, V1.2, 4.5]

- **8.14.3.20 Number of icons.** Designers should display fewer than 20 icons simultaneously on the same screen. [Source: CTA, 1996 - 3.7.3]

- **8.14.3.21 Grouping icons.** Icons should be grouped according to similar shapes and colors that depict a common relationship. [Source: CTA, 1996 - 3.7.5]

- **8.14.3.22 Icon highlighting.** Icons selected by the user should be highlighted. [Source: CTA, 1996 - 3.7.6]

- **8.14.3.23 Icon documentation.** A glossary shall be provided in on-line help containing a list of standard icons and their associated objects and actions. [Source: CTA, 1996 - 3.7.7]

- **8.14.3.24 Testing icons.** Prior to implementation, icons should be tested for effectiveness and acceptability with a representative user group. [Source: CTA, 1996 - 3.7.8]

8.14.4 Palettes

Lists and palettes are both effective ways of allowing users to access options. Palettes can be used in selection operations involving icons, patterns, colors, characters, or drawings. They allow the user to select an action or attribute from a group of icons fixed in a window. Palettes can be fixed or floating. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.7.1]

- **8.14.4.1 Use of floating palettes.** Floating palettes should be used when the attributes on the palette are utilized frequently at specific times and infrequently at others. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.7.2]

- **8.14.4.2 Floating palettes.** Floating palettes should be available through the application menus. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.7]

- **8.14.4.3 Moving floating palettes.** The user should be able to move selected floating palettes to other areas on the screen. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.7]

- **8.14.4.4 Visual feedback.** Visual feedback for the current palette selection should be provided. [Source: Apple Computer Inc., 1992 – p. 95]

- **8.14.4.5 Tool palette.** In a palette that contains tools, the selected tool should be highlighted. [Source: Apple Computer Inc., 1992 – p. 95]

- **8.14.4.6 Pattern or color palettes.** In a palette that contains patterns or colors, the currently selected item should be outlined and include a preview area that shows the effect of the current selection. [Source: Apple Computer Inc., 1992 – p. 95]

- **8.14.4.7 Selection indicator.** When the user clicks on a new palette item, the selection indicator should change to show the new item. [Source: Apple Computer Inc., 1992 – p. 95]

- **8.14.4.8 Tracking feedback.** As a user drags the cursor over the items in a palette, each item should be highlighted or outlined. [Source: Apple Computer Inc., 1992 – p. 95]

- **8.14.4.9 Active items.** Only one item in a palette should be active at a time. [Source: Apple Computer Inc., 1992 – p. 95]

- **8.14.4.10 Fixed palettes.** Fixed palettes should be permanently placed in an application environment when the attributes on the palette will be accessed frequently. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.7]

- **8.14.4.11 Fixed palette location.** Fixed palettes should be placed on the left side of the application window or along the top of the window under the title bar. [Source: Apple Computer Inc., 1992 – p. 97]

  Discussion. These positions keep the palette from interfering with standard window controls. [Source: Apple Computer Inc., 1992 – p. 96]

8.14.5 Push buttons

This section presents guidelines on push buttons (also referred to as command buttons) for general use. For specific information on the use of push buttons in windows, see the Windows section (Section 8.15).

- **8.14.5.1 Consistent appearance.** All push buttons in a window should have the same size and shape. [Source: DON UISNCCS, V1.2, 6.1]

- **8.14.5.2 Minimum push button size.** The size should accommodate the largest label. [Source: DON UISNCCS, V1.2, 6.1]

- **8.14.5.3 Labels.** A push button shall have either a text or graphic label. [Source: DON UISNCCS, V1.2, 6.1]

- **8.14.5.4 Consistent labels.** Push button labels shall be consistent throughout an application and related applications. [Source: DON UISNCCS, V1.2, 6.1.1]

- **8.14.5.5 Text label length.** Push button labels should be short and unambiguous. [Source: DON UISNCCS, V1.2, 6.1.1]

- **8.14.5.6 Push button label.** The push button label should describe the results of pressing the button and reflect the action that will be taken by the application rather than the user. [Source: DON UISNCCS, V1.2, 6.1.1]

- **8.14.5.7 Activating a push button.** A user shall be able to activate a push button by moving the pointer onto the button and pressing the appropriate pointer button. [Source: DON UISNCCS, V1.2, 6.1]

- **8.14.5.8 Activated push buttons.** The push button shall be highlighted while the pointer button is depressed. [Source: DON UISNCCS, V1.2, 6.1]

- **8.14.5.9 Activating controls using push buttons.** The control shall be activated when the pointer button is released, and the push button is reverted to its normal appearance. [Source: DON UISNCCS, V1.2, 6.1]

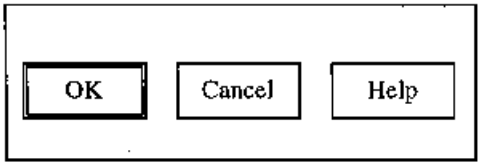
- **8.14.5.10 Activating buttons using the keyboard.** A user shall be able to activate a push button using the keyboard. [Source: DON UISNCCS, V1.2, 6.1]

- **8.14.5.11 Information prior to push button action.** When the user must supply additional information before the system can carry out a push button action, the designer should provide ellipses (…) after the push button caption to indicate that a dialog box (or control window) will be presented. [Source: CTA, 1996 - 3.6.2]

- **8.14.5.12 Default push buttons.** Default push buttons shall be clearly distinguishable from the other push buttons. [Source: DON UISNCCS, V1.2, 6.1.2]

  Example. They may have an extra border as illustrated in Exhibit 8.14.5.12, be highlighted, or appear three-dimensional. [Source: DON UISNCCS, V1.2, 6.1.2]

Exhibit 8.14.5.12 Example of a default push button.



8.14.6 Radio buttons

Definition. Radio buttons (also known as exclusive buttons or option buttons) are single, two-state choices, which are mutually exclusive from each other. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.4]

- **8.14.6.1 When to use.** Radio buttons shall be used if it is required that one and only one of a set of mutually exclusive options be selected. [Source: DON UISNCCS, V1.2, 6.2]

- **8.14.6.2 Number of radio buttons.** An individual radio button shall always be part of a mutually exclusive group of two or more radio buttons. [Source: Microsoft Corp., 1992 - 6.1.2]

- **8.14.6.3 Selecting a radio button inactivates other radio buttons.** A radio button that is active shall cause all of the other radio buttons in its group to be inactive. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.4]

- **8.14.6.4 Selecting a radio button using a pointing device.** A user shall be able to select a radio button using a pointing device by moving the pointer onto the radio button and clicking the appropriate device button. [Source: DON UISNCCS, V1.2, 6.2]

- **8.14.6.5 Selecting a radio button using the keyboard.** A user shall be able to select a radio button using the keyboard by moving a location cursor to the desired button (e.g., using the arrow keys) and pressing the **Enter** key. [Source: DON UISNCCS, V1.2, 6.2]

- **8.14.6.6 Exclusive selection.** Selecting one radio button item shall deselect any other radio button in its group previously selected. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.4]

- **8.14.6.7 Identifying a set of radio buttons.** A box should be drawn around a group of radio buttons to visually separate the group from other interface features. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.4.1]

- **8.14.6.8 Selected button highlighted.** Selecting a button that is already highlighted shall not change its state. [Source: DON UISNCCS, V1.2, 6.2]

- **8.14.6.9 Radio button labels.** Labels shall be provided for each set of radio buttons. [Source: CTA, 1996 - 3.9.4.1]

- **8.14.6.10 Labeling individual radio buttons.** Radio buttons and labels shall be left justified in the columnar format. [Source: CTA, 1996 - 3.9.4.4]

- **8.14.6.11 Labeling single panels of radio buttons.** When a screen or window contains only one panel of radio buttons, the screen or window title shall serve as the panel label. [Source: CTA, 1996 - 3.9.4.1.1]

- **8.14.6.12 Selection area.** The selection target area for radio buttons shall include the radio button and its label. [Source: CTA, 1996 - 3.9.4.6]

- **8.14.6.13 Moving a cursor to an option.** Moving the cursor to an option shall highlight the label by reverse video, reverse color, or a dashed box around the label. [Source: CTA, 1996 - 3.9.4.6.1]

- **8.14.6.14 Sets of radio buttons.** Radio button sets shall contain from two to seven items, but the user shall always have at least two radio buttons in each set. [Source: Apple Computer Inc., 1992 – p. 210]

  Discussion. When 9 or more options must be presented, consider using a scrollable list or a drop-down list instead of radio buttons. [Source: CTA, 1996 - 3.9.4.2.1]

- **8.14.6.15 Unavailable options.** When a particular option is not available, it should be displayed as subdued or grayed-out in relation to the brightness of the available options. [Source: CTA, 1996 - 3.9.4.5]

8.14.7 Check boxes

Check boxes (also known as nonexclusive buttons) are single, two-state choices. For example, a check box can be on, (checked) or off (not checked). A check box group is a collection of two-state choices, all of which apply to the same selected object. Check boxes can be grouped. [Microsoft Corp., 1992 - 6.24]

- **8.14.7.1 When to use.** Check boxes shall be provided if a user must be able to select any number including none of a set of options. [Source: DON UISNCCS, V1.2, 6.3]

  Example. In specifying the appearance of text, a user might want to select both **Bold** and **Italic**. [Source: DON UISNCCS, V1.2, 6.3]

- **8.14.7.2 Effect of activating a check box.** A check box that is activated shall not change the status of any other choice in the group. [Source: DON UISNCCS, V1.2, 6.3]

- **8.14.7.3 Selecting check boxes.** Users shall be able to toggle selected and unselected states on a check box using either a pointing device or the keyboard. [Source: DON UISNCCS, V1.2, 6.3]

- **8.14.7.4 Check box states.** Check boxes shall have two states, selected and unselected. [Source: DON UISNCCS, V1.2, 6.3]

- **8.14.7.5 Labeling check boxes.** Labels shall be provided for each set of check boxes. [Source: CTA, 1996 - 3.9.3.1]

- **8.14.7.6 Consistent labeling.** Label style and orientation for check boxes should remain consistent for groups of check boxes within an application and across related applications. [Source: CTA, 1996 - 3.9.3.5, and 3.9.3.6]

- **8.14.7.7 Arrangement of check boxes.** Check boxes shall be arranged in logical order so that the most frequently used boxes are at the top or at the left, depending on how the boxes are oriented. [Source: CTA, 1996 - 3.9.3.2]

- **8.14.7.8 Alignment of check boxes.** Check boxes should have a columnar orientation with the boxes aligned to the left. [Source: CTA, 1996 - 3.9.3.3]

- **8.14.7.9 Alignment of check boxes when space is limited.** When there is limited space, a horizontal orientation shall be used with adequate separation (three spaces) between each box. [Source: CTA, 1996 - 3.9.3.3.1]

- **8.14.7.10 Check box height and width.** When grouping check boxes, the boxes shall be equal in height and width. [Source: CTA, 1996 - 3.9.3.4]

8.14.8 List boxes

8.14.8.1 General

A **list box** presents lists of choices in a dialog box.

- **8.14.8.1.1 When to use.** List boxes should be used when choices are displayed for the user. [Source: Microsoft Corp., 1992 - 6.3.1.1]

- **8.14.8.1.2 Long lists in list boxes.** Long lists in list boxes should be accompanied by scrolling capability. [Source: Microsoft Corp., 1992 - 6.3.1.1]

- **8.14.8.1.3 Inactive list boxes.** The label and list items for an inactive list box should be dimmed. [Source: Microsoft Corp., 1992 - 6.3.1.1]

- **8.14.8.1.4 Standard single-selection list boxes.** Standard list boxes should always remain the same size. [Source: Microsoft Corp., 1992 - 6.3.1.2]

- **8.14.8.1.5 List box height.** The list box should be high enough to accommodate three to eight list items if possible within the height of a dialog box. [Source: Microsoft Corp., 1992 - 6.3.1.2]

- **8.14.8.1.6 List box width.** A list box should be a few spaces wider than the average width of the items in the list. [Source: Microsoft Corp., 1992 - 6.3.1.2]

- **8.14.8.1.7 Items too wide for list box.** When an item is too wide for the list in a list box, a horizontal scroll-bar should be placed at the bottom of the list. [Source: Microsoft Corp., 1992 - 6.3.1.2]

8.14.8.2 Drop-down list boxes

- **8.14.8.2.1 Drop-down list box.** A drop-down list box should have a fixed width. [Source: Microsoft Corp., 1992 - 6.3.1.3]

- **8.14.8.2.2 Drop-down list height when closed.** A drop-down list should be only tall enough to show one item when closed. [Source: Microsoft Corp., 1992 - 6.3.1.3]

- **8.14.8.2.3 Drop-down list when open.** The height of an opened drop-down list should be enough to accommodate three to eight items. [Source: Microsoft Corp., 1992 - 6.3.1.3]

- **8.14.8.2.4 Drop-down list with more than eight items.** Drop-down lists containing nine or more items should have a vertical scroll-bar. [Source: Microsoft Corp., 1992 - 6.3.1.3]

- **8.14.8.2.5 Extended-selection list boxes.** Extended-selection lists should be used when the user might select more than one list entry at a time from a list in which related items are contiguous. [Source: Microsoft Corp., 1992 - 6.3.2]

- **8.14.8.2.6 Multiple-selection list boxes.** Multiple-selection lists should be used when users might select several entries at a time from a list in which related items are not contiguous. [Source: Microsoft Corp., 1992 - 6.3.2]

  Discussion. Multiple-selection lists are optimized for disjoint selection, whereas extended-selection lists provide easy range selection. [Source: Microsoft Corp., 1992 - 6.3.2]

- **8.14.8.2.7 Text boxes.** The user should be able to accept, edit, delete, or replace the current text in a text box. [Source: Microsoft Corp., 1992 - 6.4]

  Definition. Text boxes are edit controls into which the user types information. Most text boxes are one line tall, but applications can also use multi-line text boxes. [Source: Microsoft Corp., 1992 - 6.4]

- **8.14.8.2.8 Entering characters in the text box.** The system should allow the user to enter characters in a text box by pressing character keys. [Source: Microsoft Corp., 1992 - 6.4.1.1]
  .

- **8.14.8.2.9 Multi-line text boxes.** Data in a multi-line text box that are too wide to fit on a single line should wrap to the following line. [Source: Microsoft Corp., 1992 - 6.4]

- **8.14.8.2.10 Combo boxes.** Combo boxes should be used when the user needs to be able to either select one of the displayed responses or enter a new response. [Source: Microsoft Corp., 1992 - 6.4.1]

  Definition. A **combo box** is a special type of text box with an attached list of options. Combo boxes allow the user to either select from the given list or type in an alternative response. There are two types of combo boxes, standard and drop-down. [Source: Microsoft Corp., 1992 - 6.4.1]

- **8.14.8.2.11 Typing options into combo boxes.** A combo box should allow the user to enter a response if the desired option is not displayed in the list. [Source: Microsoft Corp., 1992 - 6.4.1]

  Definition. Standard combo boxes include a text box and a standard list. [Source: Microsoft Corp., 1992 - 6.4.1.1]

- **8.14.8.2.12 Scroll-bar on combo box list.** The scroll-bar shall only be used on a combo box list if the list is expected to display more entries than can be shown at one time. [Source: Microsoft Corp., 1992 - 6.4.1.1]

- **8.14.8.2.13 Ordering items in combo boxes.** List entries should be organized in alphabetical order unless an application requires a different organization. [Source: Microsoft Corp., 1992 - 6.4.1.1]

- **8.14.8.2.14 Moving the selection in the list.** A user should be able to move up and down the list of a combo box with input focus by using the up and down arrow keys. [Source: Microsoft Corp., 1992 - 6.4.1.1]

- **8.14.8.2.15 Moving left and right in an edit field.** The user should be able to move the cursor left or right in the edit field of the combo box by using the left or right arrow keys. [Source: Microsoft Corp., 1992 - 6.4.1.1]

- **8.14.8.2.16 Drop-down combo boxes.** Drop-down combo boxes should be used instead of standard combo boxes when the space is limited. [Source: Microsoft Corp., 1992 - 6.4.1.2]

  Definition. A **drop-down combo box** consists of a text box, a down arrow button, and a drop-down list. [Source: Microsoft Corp., 1992 - 6.4.1.2]

- **8.14.8.2.17 Width of drop-down combo box.** The list segment of an open drop-down combo box should extend to the right border of the down arrow button. [Source: Microsoft Corp., 1992 - 6.4.1.2]

- **8.14.8.2.18 Spin box options.** A spin box should be used for a limited set of discrete, ordered options and to display values that consist of several subcomponents. [Source: Microsoft Corp., 1992 - 6.4.2]

  Definition. A **spin box** (also known as a **spin button**) is a variation of the scrolling menu or list. Spin boxes are specialized text boxes that accept only a limited set of discrete, ordered input values. A spin box includes a text box with a pair of arrows attached to the right side of the text box that allow a user to display a sequence of mutually exclusive choices, for example, months of the year. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.3.2]

- **8.14.8.2.19 Entering values into spin boxes.** The spin box should allow the user to enter a new value into the text box that is not available presently as one of the options. [Source: Microsoft Corp., 1992 - 6.4.2]

- **8.14.8.2.20 Increasing and decreasing spin box values.** The user should be able to increase the value in a spin box by clicking the **UP ARROW** key or decrease the value by clicking the **DOWN ARROW** key. [Source: Microsoft Corp., 1992 - 6.4.2]

- **8.14.8.2.21 Arrows on a spin box.** Spin box arrows should operate like scroll-bar arrows for a concealed descending list. [Source: Microsoft Corp., 1992 - 6.4.2]

8.14.9 Special graphical controls

A graphic control allows for a simple interpretation of what the control represents and how it works. Specially designed graphics maintain this idea with each graphic being unique in appearance and function. A specialized graphic clearly represents an actual physical object and is only used when it is less complicated than other options offered by the application. Examples of graphical controls include sliders, volume knobs, color wheels, and color sliders. [Source: Ameritech Services Inc., 1996 - 4.1.1.1.8]

- **8.14.9.1 When to use sliders.** Sliders are appropriate and should be used when users must set a value within a fixed range and the precise value is less important than relative position. [Source: Open Look GUISG, p. 368]

  Definition. A **slider** is a control used to set a value and give a visual indication of the setting. [Source: Open Look GUISG, p. 368]

  Example. Sliders can be used when setting the volume level of a tone signal. [Source: Open Look GUISG, p. 368]

- **8.14.9.2 Components of a slider.** A slider shall have a movable marker that indicates the current setting and a line or rectangular area along which it moves. [Source: DON UISNCCS, V1.2, 6.7]

  Discussion. Tick marks and numeric values may be added to the line or rectangular area of the slider. [Source: DON UISNCCS, V1.2, 6.7]

- **8.14.9.3 Readout.** When appropriate, the slider should provide a numerical readout of the current setting. [Source: DON UISNCCS, V1.2, 6.7]

- **8.14.9.4 Slider operation.** Users shall be able to change the setting of a slider by moving the pointer onto the marker and dragging it. [Source: DON UISNCCS, V1.2, 6.7]

- **8.14.9.5 Labeling sliders.** A slider shall have a label or title that indicates the purpose of the slider. [Source: DON UISNCCS, V1.2, 6.7]

8.14.10 Cursors

8.14.10.1 General

- **8.14.10.1.1 Multiple cursors.** Multiple cursors shall be avoided unless needed for user tasks. [Source: MIL-HDBK-761A, 5.2.3.1.a]

- **8.14.10.1.2 Distinguishing cursors.** When more than one cursor is provided, each shall be easily distinguishable from the other(s), with the status of each (active or inactive) being easily distinguishable. [Source: MIL-HDBK-761A, 5.2.3.1.a]

- **8.14.10.1.3 Cursor movement.** When entering and editing text, users shall be able to move the cursor freely within a displayed page to specify items for change and to make changes directly in the text. [Source: MIL-HDBK-761A, 5.2.3.1.a]

- **8.14.10.1.4 Enhanced cursor movement.** As applicable, users should be able to move the cursor by units of character, line, and page. [Source: MIL-HDBK-761A, 5.2.3.c]

8.14.10.2 Text cursor

- **8.14.10.2.1 Text cursor.** The text cursor shall be an I-beam in insert mode and a box over a character in replace mode. [Source: DON UISNCCS, V1.2, 2.3.3.1]

- **8.14.10.2.2 Text cursor height.** The height of an I-beam text cursor shall be the same as that of the adjacent text character. [Source: Nuclear Regulatory Commission, 1996 - 2.3.6-6]

- **8.14.10.2.3 Text cursor flash rate.** The text cursor shall flash at a rate between 2 and 5 Hz. [Source: DON UISNCCS, V1.2, 2.3.3.1]

  Discussion. A blink rate of 2 to 3 Hz with a 50% duty cycle is preferred. With a 50% duty cycle, the cursor would be ON half the time and OFF half the time. In some systems, users are allowed to set the blink rate for a location cursor through window management functions.

- **8.14.10.2.4 Avoiding flashing-induced seizures.** Flash or display refresh rate shall not be within the 15-20 Hz range. [Source: Vanderheiden & Vanderheiden, 1991. O-7, p. 36]

  Discussion. People who are sensitive to seizures may have seizures induced by flashing screen cursors or by flickering displays, particularly near the 15-20 Hz range. Therefore, flicker or refresh rates should be as far above or below this range as possible or practical. [Source: Vanderheiden & Vanderheiden, 1991. O-7, p. 36]

- **8.14.10.2.5 Lost input focus.** When the text object containing the text cursor loses input focus, the cursor shall stop flashing. [Source: DON UISNCCS, V1.2, 2.3.3.1; Ameritech Services Inc., 1996 - 3.2.1.1]

- **8.14.10.2.6 Regained text object input focus.** When the text object regains input focus, the cursor shall return to normal brightness and resume flashing. [Source: Ameritech Services Inc., 1996 - 3.2.1.1; DON UISNCCS, V1.2, 2.3.3.1]

  Discussion. Input focus means that the indicated location, window, or object in the text field is currently active. Unless the user changes this active state, that will be the object or location that will be acted upon by the next text editing or entry transaction. [Source: DON UISNCCS, V1.2, 2.3.3.1; Ameritech Services Inc., 1996 - 3.2.1.1]

- **8.14.10.2.7 Text cursor location.** When a window first receives input focus, the text cursor shall be placed in the text area where typing is most likely to occur. [Source: DON UISNCCS, V1.2, 2.3.3.1]

- **8.14.10.2.8 Regaining widow input focus.** When the cursor disappears from view when its window loses focus, the cursor shall reappear at the same location when the window regains focus. [Source: DON UISNCCS, V1.2, 2.3.3.1]

- **8.14.10.2.9 Input device for moving the text cursor.** Users shall be able to move the text cursor within and among text entry areas using both the pointing device and the keyboard. [Source: DON UISNCCS, V1.2, 2.3.3.1]

- **8.14.10.2.10 Cursor home position for common work area.** The home position for the cursor should be consistent across similar types of displays in a common work area. [Source: Department of Defense, 1996 - 5.15.2.1.8.3]

- **8.14.10.2.11 Text cursor display.** The pointer shall change to an I-beam (text cursor) only when the pointer moves into an area in which text entry is possible. [Source: DON UISNCCS, V1.2, 2.3.3.1]

- **8.14.10.2.12 Moving text cursor out of text entry area.** Users shall not be able to move the text cursor into areas in which text entry is not possible. [Source: DON UISNCCS, V1.2, 2.3.3.1]

8.14.10.3 Graphics cursor

- **8.14.10.3.1 Graphics cursor.** The cursor for creating graphics displays should be distinctive, easy to position, and have a point that can be used to select and manipulate small graphic objects. [Source: MIL-HDBK-761A, 5.2.6.1.a, 5.2.6.1.b]

8.14.10.4 Cursor as a status indicator

Changing the shape of the cursor is one way that an application might indicate the current status when an operation in progress takes more than 2 or 3 seconds to complete and the user cannot continue working in that application until the operation finishes. [Source Microsoft Corp., 1992 - 3.6.1.1.3]

- **8.14.10.4.1 Distinctiveness of cursor as status indicator.** A cursor used as a status indicator should be distinct from the normal cursor. [Source Microsoft Corp., 1992 - 3.6.1.1.3]

- **8.14.10.4.2 Reverting to normal cursor in accessible windows.** When the user moves the pointer to a second, accessible window, the normal pointer for that window should appear. [Source Microsoft Corp., 1992 - 3.6.1.1.3]

- **8.14.10.4.3 Graphics cursor operation.** A graphics cursor operation should have a movement (pointing) component that positions the cursor and an activation component that activates the position to manipulate a display element (e.g., selecting an object to move or drawing a line). [Source: MIL-HDBK-761A, 5.2.6.1.c; DOE HFDG ATCCS, V2.0, 2.1.18.3]

8.14.10.5 Position or pointing cursors

Position or pointing cursors are used to point to controls on a display. They may at times obscure other screen objects. The pointer cursor is often the left pointing arrow. The pointer is used to make selections and to click in menus and control buttons; to resize windows; to click, hold, and drag objects, and to click on a location to move the location cursor in text and field editing. [Source: Ameritech Services Inc., 1996 - 3.2.1, 3.2.1.1,and 3.2.1.2]

- **8.14.10.5.1 Size.** Position or pointing cursors shall maintain their size across all screen locations during movement. [Source: Ameritech Services Inc., 1996 - 3.2.1.2]

- **8.14.10.5.2 Blink.** Position or pointing cursors shall not blink [Source: Ameritech Services Inc., 1996 - 3.2.1, 3.2.1.1,and 3.2.1.2]

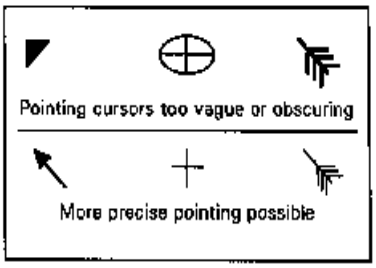
- **8.14.10.5.3 Rate of movement.** Position or pointing cursors shall move rapidly in response to the pointing device (less than 100 msec). [Source: Ameritech Services Inc., 1996 - 3.2.1.2]

- **8.14.10.5.4 Pointer visibility.** The pointer should disappear when a user begins typing and reappear when the user stops typing or when he or she moves the pointing device. [Source: DON UISNCCS, V1.2, 2.3.3.1]

- **8.14.10.5.5 Movement.** Position or pointing cursors shall not move without input of the user. [Source: Ameritech Services Inc., 1996 - 3.2.1.2]

- **8.14.10.5.6 Hotspot.** A pointer shall have a hotspot, that is, an active point (although this active point may not be readily apparent to the user) to indicate the precise location where an operation will occur. These points are specified for a variety of pointer shapes in Exhibit 8.14.10.5.6 [Source: DOE HFDG ATCCS, V2.0, 7.5.1]

Exhibit 8.14.10.5.6 Examples of better and worse pointing cursors.



Definition. A **hotspot** for a pointer is the precise part of a screen pointer that marks the screen position where an operation on a pointing device will have an effect. [Source: DOE HFDG ATCCS, V2.0, 7.5.1]

8.14.10.6 Pointer shapes

- **8.14.10.6.1 General-purpose pointer shape.** An arrow pointing up and to the left (↖) shall be the general-purpose pointer. [Source: DOE HFDG ATCCS, V2.0, 5.3.4.4]

- **8.14.10.6.2 Redefining pointer shape.** An application shall redefine the shape of a pointer only when the pointer is inside an application window (including the border). [Source: DOE HFDG ATCCS, V2.0, 5.3.4.4]

- **8.14.10.6.3 Limit pointer shapes.** The designer shall use only those pointer shapes necessary for user understanding of the functionality. [Source: Ameritech Services Inc., 1996 - 3.2.1]

- **8.14.10.6.4 Hotspot and pointer shape.** The screen location of a hotspot shall not change if the pointer changes from one shape to another. [Source: DOE HFDG ATCCS, V2.0, 7.5.2]

- **8.14.10.6.5 When to create new pointer shapes.** When no adequate pointer shape exists, such as those depicted in Exhibit 8.14.10.6.5, a new pointer should be created. [Source: DOE HFDG ATCCS, V2.0, 7.5.3]

Exhibit 8.14.10.6.5 Pointer shapes associated with

Shape	Name	Function	Hotspot
	Arrow	**Pointing.** Used in most window areas for object selection.	The point of the arrow.
	I-beam	**Pointing.** Used in text areas to position the text cursor and perform actions on text. The I-beam pointer is hidden during the time between any keyboard action and pointer movement (that is, when text entry is occurring at the location of the text cursor).	On the vertical bar of the I-beam about one-third from the top.
	Watch (or hourglass)	**Working.** Indicates that an operation is being performed in a window area. When the working pointer is displayed, all pointing device and keyboard actions are ignored in the area.	Not applicable
	Caution sign	**Caution.** Indicates that action is expected in another window area before input can be made in the current area and that the pointer has no effect in the area. When the caution pointer is displayed, all pointing device and keyboard actions are ignored in the area.	Not applicable
	Resize pointer	**Resize.** Indicates positions for area resize, with the direction of the arrow in the pointer indicating the direction of increasing size. The horizontal and vertical resize pointers indicate resize in either the horizontal or vertical direction. The diagonal resize pointers indicate resize in both the horizontal and vertical directions simultaneously. The resize pointer appears when the pointer is on the frame border.	On the corner or line at the position pointed to by the arrow.
	Move arrows	**Moving.** Indicates a move operation in progress or a resize operation before the resize direction has been determined. During a resize operation, the four-directional arrow pointer indicates a direction for resizing and changes to the appropriate resize arrow when the pointer is on the frame border.	The intersection of the arrows.
+	Sight or cross	**Sighting.** Used to make fine position selections (for example, to select a location on a map display).	The intersection of the lines.

- ▫ **8.14.10.6.6 How to create new pointer shapes.** The new shape should be easy to see, obscure as little information as possible on the screen, have a hotspot that is obvious and easy to locate, provide a hint of its purpose, and not be easily confused with other objects on the screen. [Source: DOE HFDG ATCCS, V2.0, 7.5.3]

8.14.10.7 Location cursors

Location cursors serve to show the location of an operation on a display. The location pointer is usually an I-beam cursor in text processing or data entry.

- ▪ **8.14.10.7.1 Distinctive against background.** Location cursors shall be distinctive against their backgrounds. [Source: Ameritech Services Inc., 1996 - 3.2.1.1]
- ▪ **8.14.10.7.2 Obscuring characters.** Location cursors shall not obscure characters. [Source: Ameritech Services Inc., 1996 - 3.2.1.2]
- ▫ **8.14.10.7.3 Blink rate.** The blink rate for location cursors should be somewhere between 2 to 3 Hz. [Source: Ameritech Services Inc., 1996 - 3.2.1.1]
- ▫ **8.14.10.7.4 Duty cycle.** Location cursors should have a 50% (half on half off) duty cycle. [Source: Ameritech Services Inc., 1996 - 3.2.1.1]

8.15 Windows

This section contains guidelines on windows with the exception of help windows, which is presented in the section 8.18, Help.

8.15.1 General

Definitions. Windows can be either modal or modeless. A **modal** window is a window with which a user must interact before being able to interact with any other windows. That is, a user cannot interact with other windows as long as the modal window is displayed. When a window is **modeless**, a user can interact with other windows.

- **8.15.1.1 Hardware limitations on the use of windowing.** Windowing shall be avoided when the hardware has limitations. These limitations include

  a. small screen size resulting in frequent manipulation of the screen by the user;

  b. slow processing speed resulting in slow operation by the computer; or

  c. low screen resolution resulting in less effective visual coding, especially for map graphics, symbols, and icons. [Source: DOE HFDG ATCCS, V2.0, 7.1.1]

- **8.15.1.2 User-specified windows.** When there is a need to view several different types of data simultaneously, the user shall be able to display and select separate windows on a single CRT screen. [Source: DOE HFDG ATCCS, V2.0, 7.1.2.1]

- **8.15.1.3 Number of allowable open windows.** The number of allowable open windows shall not compromise system response time. [Source: DOE HFDG ATCCS, V2.0, 7.1.4]

  Discussion. Each open window requires system resources in terms of memory and processing speed. A limit on the maximum number of windows that can be effectively opened for each system needs to be predetermined. [Source: DOE HFDG ATCCS, V2.0, 7.1.4]

- **8.15.1.4 Window size.** Windows should be large enough to: present all relevant information for the task, not obscure important information, not cause crowding or visual confusion, and minimize the need for scrolling. [Source: National Air Traffic Services, 1999 - 1.10.2.6.2]

- **8.15.1.5 Window default size.** The default size of the window should be less than the full size of the entire screen. [Source: National Air Traffic Services, 1999 - 1.10.2.6.2]

- **8.15.1.6 Window default location.** Each window shall have a default location at which the window appears when it is first opened. [Source: DON UISNCCS, V1.2, 4.3.1.1]

- **8.15.1.7 Minimum window size for text.** Windows used to present text should be at least 12 lines tall. [Source: National Air Traffic Services, 1999 - 1.10.2.6.2]

- **8.15.1.8 Minimum window size for alphanumeric information.** Windows used to present alphanumeric information should be at least 7 lines tall. [Source: National Air Traffic Services, 1999 - 1.10.2.6.2]

- **8.15.1.9 Minimum window size.** The minimum window size should permit the display of the title and menu bar, if any. [Source: DON UISNCCS, V1.2, 8.6.2]

- **8.15.1.10 Consistency in window organization.** The windows in an application and related applications shall have a consistent organizational scheme for the key elements of the windows. [Source: DON UISNCCS, V1.2, 8.5.7]

- **8.15.1.11 Elements to include in windows.** Individual windows shall contain only those elements appropriate to the particular task, but the elements shall be consistent from window to window throughout the application. [Source: DON UISNCCS, V1.2, 8.5.7]

- **8.15.1.12 Initial window contents and organization.** The initial contents and organization of a window should permit a user to accomplish the window purpose easily and efficiently. [Source: DON UISNCCS, V1.2, 8.6.1]

- **8.15.1.13 Initial size.** When possible, the initial size of a window should permit the display of all its contents. [Source: DON UISNCCS, V1.2, 8.6.2]

- **8.15.1.14 Initial placement.** The initial placement of a window should be based on

  a. the importance of the information (critical information should be placed in the center of the user's field of view),

  b. information already displayed that should not be obscured,

  c. the distance from the current pointer location (pointer movement should be minimized), and

  d. when applicable, information already displayed that is relevant to the window. [Source: DON UISNCCS, V1.2, 8.6.2]

8.15.2 Window components

This section contains general guidelines on particular window components. Look to the specific window types (Section 8.15.3) to find type-specific information on each of these components.

8.15.2.1 Title bar and title

- **8.15.2.1.1 Use.** A title bar shall appear as a rectangular area at the top of a window inside the window border and with the title of the window in the center. [Source: DON UISNCCS, V1.2, 4.1.1]

- **8.15.2.1.2 Title bar controls.** Window title bars should contain a control at the left end that, when activated, produces a menu of window management options and **Minimize**, **Maximize/Restore,** and **Close** controls at the right end. [Source: DON UISNCCS, V1.2, 4.1.1]

  Discussion. Guidelines for the operation of these controls are presented in section 8.15.6 dealing with window operations. [Source: DON UISNCCS, V1.2, 4.1.1]

- **8.15.2.1.3 Titles for primary windows.** The title shall be the application name followed by the opened file name, separated by a single dash (-). [Source: Ameritech Services Inc., 1996 - 3.1.1.2 .4]

- **8.15.2.1.4 Multiple instances of opening the same file or object.** When the user has the multiple instances of the same object or file open simultaneously, then each instance should be titled with a colon and an instance number appended to the title in the order that it was opened. [Source: Ameritech Services Inc., 1996 - 3.1.1.2.4]

  Example. When the file is named myreport.doc, the second instance of opening that same document file since the computer and software was booted would be myreport:2 in the title bar. The first instance title bar would change to myreport:1 in its title bar when both are open simultaneously. [Source: Ameritech Services Inc., 1996 - 3.1.1.2.4]

- **8.15.2.1.5 Titles for secondary windows.** Titles shall begin with the object under focus and be followed by the action underway. [Source: Ameritech Services Inc., 1996 - 3.1.1.2.4]

  Example. Printer - Set Up is the title with the printer being the object under focus and the action underway is a set-up action. [Source: Ameritech Services Inc., 1996 - 3.1.1.2 .4]

- **8.15.2.1.6 Capitalization in window titles.** Significant words in the title (except user-defined words) shall be capitalized. [Source: Ameritech Services Inc., 1996 - 3.1.1.2.4]

8.15.2.2 Border

- **8.15.2.2.1 Border.** A window should have a distinct border that encloses all of the window components. [Source: DON UISNCCS, V1.2, 4.1.1]

8.15.2.3 Working or client area

- **8.15.2.3.1 Working or client area of windows.** Every window shall have a working or client area. [Source: Ameritech Services Inc., 1996 - 3.1.1.2.2]

  Definition. Working area (or client area) is the main area of the window that users employ to do their operational or application tasks. It is the area where users make their inputs and receive their outputs. [Source: Ameritech Services Inc., 1996 - 3.1.1.2.2]

8.15.2.4 Scroll-bars

- **8.15.2.4.1 When to use.** Scroll-bars shall be provided whenever the size of a textual or graphic entity exceeds the space available to display it. [Source: DON UISNCCS, V1.2, 6.6]

- **8.15.2.4.2 When not to use.** When the entire document fits in a display area, scroll-bars are unnecessary and shall be deactivated. [Source: Ameritech Services Inc., 1996 - 3.1.1.5.1]

- **8.15.2.4.3 Directional preference for scrolling.** When there is a choice, vertical (top-to-bottom) scrolling should be used instead of horizontal (left to right) scrolling. [Source: Galitz, 1993 - 1.10.2.4.2.8.9]

- **8.15.2.4.4 Scroll-bars on active windows.** Scroll-bars shall be displayed in full contrast for the active window only (the window that displays the user's current input). [Source: CTA, 1996 - 6.1.1.3.3; DON UISNCCS, V1.2, 9.3.1]

- **8.15.2.4.5 Vertical scroll-bar size.** A vertical scroll-bar should be the height of the scrollable portion of the window. [Source: National Air Traffic Services, 1999 - 1.10.2.4.2.8.7]

- **8.15.2.4.6 Horizontal scroll-bar size.** A horizontal scroll-bar should be at least one-half the width of the scrollable portion of the window. [Source: National Air Traffic Services, 1999 - 1.10.2.4.2.8.7]

- **8.15.2.4.7 Changing scroll-bar components.** Scroll-bar components shall change when the window size or information position changes reflecting the present status. [Source: National Air Traffic Services, 1999 - 1.10.2.4.2.8.10.1]

- **8.15.2.4.8 Arrows to indicate direction of scrolling.** Directional arrows should be provided in small boxes distinct from the scroll area to indicate the direction that scrolling may be performed. [Source: National Air Traffic Services, 1999 - 1.10.2.4.2.8.8.2]

  Discussion. Up/down arrows would indicate vertical scrolling direction and left/right arrows would indicate horizontal scrolling direction. [Source: National Air Traffic Services, 1999 - 1.10.2.4.2.8.8.2]

- **8.15.2.4.9 Subdued directional arrows.** The appropriate directional arrow shall be subdued or grayed out if no information is currently available through scrolling in a particular direction. [Source: National Air Traffic Services, 1999 - 1.10.2.4.2.8.10.2]

- **8.15.2.4.10 Scroll area or container.** The scroll-bar should be contain a filled-in bar, which contrasts with the window and the screen body background. [Source: National Air Traffic Services, 1999 - 1.10.2.4.2.8.5]

- **8.15.2.4.11 Scroll-bar entire-entity indicator.** A scroll-bar shall contain a vertical or horizontal line or area along which the scroll box can move, the length of which represents the entire entity. [Source: DON UISNCCS, V1.2, 6.6]

- **8.15.2.4.12 Scroll box.** A scroll-bar shall contain a movable symbol such as a box or rectangle that contrasts with the scroll area. [Source: National Air Traffic Services, 1999 - 1.10.2.4.2.8.6.1]

  Discussion. The scroll box is also known as the slider box or scroll handle. [Source: National Air Traffic Services, 1999 - 1.10.2.4.2.8.6.1]

- **8.15.2.4.13 Scroll box position.** The scroll box should indicate by its spatial position the relative location in the file of the information being viewed. [Source: National Air Traffic Services, 1999 - 1.10.2.4.2.8.6.1]

- **8.15.2.4.14 Scroll box size.** The size of the scroll box shall indicate proportionately the amount of the document displayed in the window relative to the percentage of available information in the file being viewed. [Source: National Air Traffic Services, 1999 - 1.10.2.4.2.8.6.1]

  Discussion. If the document is short, the displayed amount of the document is large and thus so is the scroll box. If the document is long, then the displayed amount and scroll box are small. For long documents, a minimal or default size scroll box is used. [Source: Ameritech Services Inc., 1996 - 3.1.1.5.1]

- **8.15.2.4.15 Indicating page number of viewed page.** When selected with the pointing device, the scroll box should display within it or near it the page number of material to be viewed. [Source: National Air Traffic Services, 1999 - 1.10.2.4.2.8.6.2]

- ▫ **8.15.2.4.16 Indicating selected scroll box.** When the scroll box has been selected, it should be indicated to the user in some visually distinctive way. [Source: National Air Traffic Services, 1999 - 1.11.15.6].

- ▪ **8.15.2.4.17 Scroll box operations.** Users shall be able to drag the scroll box continuously along its line or area using a pointing device. [Source: National Air Traffic Services, 1999 - 1.10.2.4.2.8.6.1]

- ▪ **8.15.2.4.18 Stepping through units using a scroll-bar.** A scroll-bar shall contain two symbols that allow a user to step forward or backward through the entire entity a unit at a time (e.g., one page at a time). [Source: DON UISNCCS, V1.2, 6.6]

8.15.2.5 Message bar

The information area in primary windows is called the message bar or message area.

- ▫ **8.15.2.5.1 Location of message bar.** The message bar should be placed near the bottom of an active window. [Source: Microsoft Corp., 1992 - 4.2.6]

- ▫ **8.15.2.5.2 Use of message bar.** The message bar should display status information about a selection, a command, or a process; display help information; and explain highlighted menu items. [Source: Microsoft Corp., 1992 - 4.2.6]

- ▫ **8.15.2.5.3 Messages longer than the message bar.** Messages too long to be presented in the message bar should be displayed in message dialog boxes. [Source: Microsoft Corp., 1992 - 4.2.6]

- ▫ **8.15.2.5.4 Display of message bar.** The user should be able to turn the message bar on or off by a menu selection. [Source: Microsoft Corp., 1992 - 4.2.6]

- ▫ **8.15.2.5.5 Automatic removal of messages.** The message bar should automatically remove messages that are no longer relevant. [Source: Ameritech Services Inc., 1996 – 5.3.3.2]

- ▪ **8.15.2.5.6 Message types.** The message bar shall be a read-only, non-scrolling display for messages. [Source: Ameritech Services Inc., 1996 – 5.3.3.2]

- **8.15.2.5.7 Text placed in information area.** Text placed in the information area should be helpful but non-critical application messages to users. [Source: Ameritech Services Inc., 1996 – 5.3.3.2]

  Examples. The information can be about settings in use by the application or about objects being manipulated. The information area can be used to present information concerning a command, menu item, or button under cursor focus (it may even be information about the results of selecting the item). It could be used to suggest the default action, the most appropriate action, or how to perform actions under cursor focus. Other uses are to tell (instruct) how many items in a focused list box can be selected, (e.g., select one or select as many as apply) or to inform the user that an action has been successfully completed. [Source: Ameritech Services Inc., 1996 – 5.3.3.2]

- **8.15.2.5.8 Location for routine messages.** The left side of a message bar should be used for routine, simple help, and status messages. [Source: DON UISNCCS, V1.2, 8.1.4]

- **8.15.2.5.9 Location for window information.** The right side of a message bar should be used to present information about the window, such as the name of an object or the page number. [Source: DON UISNCCS, V1.2, 8.1.4]

8.15.2.6 Status bar

- **8.15.2.6.1 Status bar.** The status bar should present information about the current state of the application including brief messages, current cursor location, and mode. [Source: Microsoft Corp., 1992 - 4.2.7]

  Definition. The status bar is a special type of the message bar used to present information about the current status of the application. [Source: Microsoft Corp., 1992 - 4.2.7]

- **8.15.2.6.2 Indication of normal modes.** The status bar should indicate normal or default modes by the absence of the indicator for the non-normal modes. [Source: Microsoft Corp., 1992 - 4.2.7]

- **8.15.2.6.3 Display of status bar.** Users should be provided with a means to control whether or not to display the status bar. [Source: Microsoft Corp., 1992 - 4.2.7]

8.15.2.7 Control bar

Control bars can be rulers, such as in word processing programs or toolboxes and color/pattern palettes, such as in graphics programs. [Source: Microsoft Corp., 1992 - 4.2.8]

- **8.15.2.7.1 Use.** Control bars should be used for frequently used features and commands. [Source: Microsoft Corp., 1992 - 4.2.8]

- **8.15.2.7.2 Position.** Fixed control bars should located at a fixed position within the application window, and movable control bars should be placed in a supplemental window or a dialog box, able to be moved to a position selected by the user. [Source: Microsoft Corp., 1992 - 4.2.8]

- **8.15.2.7.3 Commands for fixed-position control bars.** Commands for fixed-position control bars in the main application window should be displayed as options under the **View** menu. [Source: Microsoft Corp., 1992 - 4.2.8]

- **8.15.2.7.4 Display of control bars.** Users should be allowed to specify which control bars, if any, they wish to display. [Source: Microsoft Corp., 1992 - 4.2.8]

- **8.15.2.7.5 Location relative to window.** A window shall never conceal the movable control bar with which it is associated. [Source: Microsoft Corp., 1992 - 4.2.8]

- **8.15.2.7.6 Movable control bar components.** A small title bar and control menu box should be provided for each movable control bar. [Source: Microsoft Corp., 1992 - 4.2.8]

  Discussion. It is not necessary for the title bar of a movable control bar to contain a title; its main function is to allow the user to drag the control bar to a new position. [Source: Microsoft Corp., 1992 - 4.2.8]

8.15.2.8 Push buttons

This section presents guidelines for push buttons specific to their use in windows. Additional, more general information on push buttons is presented in Section 8.14.5, Push buttons.

- **8.15.2.8.1 Push button location.** The top, bottom, or sides of the working area should be reserved for push buttons that provide actions that can be taken in the window. [Source: DON UISNCCS, V1.2, 8.1.3.2]

- **8.15.2.8.2 Display of push buttons.** The push buttons should be displayed in a horizontal row or vertical column centered with the window. [Source: DON UISNCCS, V1.2, 8.1.3.2]

- **8.15.2.8.3 Same buttons in different windows.** When the same buttons are used for different windows, they should be placed consistently in the same location. [Source: DON UISNCCS, V1.2, 8.1.3.2]

- **8.15.2.8.4 Consistent order.** Push button order should be consistent throughout an application. [Source: DON UISNCCS, V1.2, 8.1.3.2]

- **8.15.2.8.5 Help button.** When **Help** may be needed by the user and does not appear in a window menu bar, the window should have a **Help** button located at the bottom right corner of the working area of the window. [Source: DON UISNCCS, V1.2, 8.1.3.2].

- **8.15.2.8.6 Button order.** Buttons should be ordered from left to right (or top to bottom for vertical rows) according to frequency of use, sequence of use, or with positive actions at the left or top and negative or canceling actions at the right or bottom. [Source: DON UISNCCS, V1.2, 8.1.3.2]

- **8.15.2.8.7 Number of default buttons.** Designers should use no more than one default button in a control window. [Source: Ameritech Services Inc., 1996 – 3.1.2.2.5]

- **8.15.2.8.8 Location of default button.** When a default button is used in a control window, it should be the leftmost or topmost button. [Source: Ameritech Services Inc., 1996 – 3.1.2.2.5]

- **8.15.2.8.9 Push buttons not to use as default.** A push button assigned an action that is potentially destructive shall not be designated as the default button. [Source: DON UISNCCS, V1.2, 6.1.2]

- **8.15.2.8.10 Grouping related buttons.** Related push buttons should be placed together. [Source: CTA, 1996 - 3.6.3]

- **8.15.2.8.11 Visibility of buttons.** When push buttons are required for system interaction, they should always be visible on a primary display. [Source: Ameritech Services Inc., 1996 - 3.1.2.2.5.]

8.15.2.9 Action icons

- **8.15.2.9.1 Action icons.** When a window includes action icons, they should be arranged along the left margin of the window. [Source: DON UISNCCS, V1.2, 8.1.3.3]

- **8.15.2.9.2 Number of action icons.** The number of action icons in a window should not exceed 20. [Source: DON UISNCCS, V1.2, 8.1.3.3]

- **8.15.2.9.3 Action icons bound to window.** When a window includes action icons, a user shall not be able to move the icons outside the window. [Source: DON UISNCCS, V1.2, 8.1.3.3]

8.15.3 Window types

8.15.3.1 Primary and secondary windows

Definitions. A **primary window** is a top or high-level window in an application. A **secondary window** is a window that is displayed from within a primary window or another secondary window. Secondary windows are sometimes called child windows.

- **8.15.3.1.1 Primary windows.** A primary window shall contain a title bar, a border, window controls, and a working area or client area. [Source: DON UISNCCS, V1.2, 4.1.3]

  Discussion. The primary window may also contain a menu bar, controls, objects, and icons. [Source: DON UISNCCS, V1.2, 4.1.3]

- **8.15.3.1.2 Message area in primary windows.** Primary windows should have message areas. [Source: DON UISNCCS, V1.2, 8.1.4]

  Discussion. The message area may be a dedicated area or it may be an area that is used temporarily when a message is presented but is available for other uses otherwise. [Source: DON UISNCCS, V1.2, 8.1.4]

- **8.15.3.1.3 Application primary window.** Every application should initially display a primary window. [Source: Ameritech Services Inc., 1996 - 3.1.1.1.1]

  Discussion. Displaying a primary window provides an initial application context for the user. [Source: Ameritech Services Inc., 1996 - 3.1.1.1.1]

8.15.3.1.4 When to display a primary window. Applications should display a primary window as soon as the application starts, without leaving the screen blank. [Source: Ameritech Services Inc., 1996 - 3.1.1.1.1]

- **8.15.3.1.5 Multiple primary window capability.** As necessary for performance of the intended user tasks, an application should be capable of having multiple primary windows open at the same time. [Source: Ameritech Services Inc., 1996 - 3.1.1.1.1]

- **8.15.3.1.6 Independence of primary windows.** Primary windows should be independent of one another in the application. [Source: Ameritech Services Inc., 1996 - 3.1.1.1.1]

  Example. Multiple spreadsheets may be open at the same time.

- **8.15.3.1.7 Secondary windows.** A secondary window shall contain a title bar, a working area, and any of the other window components appropriate to the application. [Source: DON UISNCCS, V1.2, 4.1.3]

- **8.15.3.1.8 When to use.** A secondary window should be used to temporarily add data (e.g., help screens, menus, or other features) to a display as a means to control or display divergent information or to segregate and control separate operations. [Source: CTA, 1996 - 6.2.2.3]

- **8.15.3.1.9 Secondary window constraints.** A secondary window should be associated with a particular primary or other secondary window. [Source: OSF/Motif Style Guide, 5.2.2]

- **8.15.3.1.10 Calling up other secondary windows.** A secondary window should be able to call up additional secondary windows to further the interaction. [Source: Ameritech Services Inc., 1996 - 3.1.1.1.2.2]

- **8.15.3.1.11 Placement of secondary windows.** When present, a secondary window should appear within the borders of and on top of (superimposed on) a portion of its "parent" window. [Source: OSF/Motif Style Guide, 5.2.2]

- **8.15.3.1.12 Closing a secondary window.** Closing a secondary window should not affect the parent window. [Source: OSF/Motif Style Guide, 5.2.2]

- **8.15.3.1.13 Removing secondary windows.** A secondary window should be removed when its parent window is removed. [Source: OSF/Motif Style Guide, 5.2.2]

- **8.15.3.1.14 Number of secondary windows.** The number of secondary windows should be limited to avoid creating navigation problems for the user. [Source: CTA, 1996 - 6.2.2.1]

- **8.15.3.1.15 Secondary windows covering primary window.** Secondary windows should not cover any part of the primary window that a user needs to see or use to do his or her task. [Source: Ameritech Services Inc., 1996 - 3.1.1.1.2.2]

- **8.15.3.1.16 Modeless secondary windows.** Modeless secondary windows should provide dialogs that do not require immediate attention and commands that do not need to be done before moving on. [Source: Ameritech Services Inc., 1996 - 3.1.1.1.2.2.2]

- **8.15.3.1.17 Moving modeless secondary windows.** Modeless secondary windows should themselves be moveable. [Source: Ameritech Services Inc., 1996 - 3.1.1.1.2]

- **8.15.3.1.18 Modal secondary windows.** Designers should only use modal secondary windows for serious problems for which an explicit response is required of the user before continuing. [Source: Ameritech Services Inc., 1996 - 3.1.1.1.2.2]

- **8.15.3.1.19 Moving modal secondary windows.** Modal secondary windows should not be movable. [Source: Ameritech Services Inc., 1996 - 3.1.1.1.2]

8.15.3.2 Application windows

- **8.15.3.2.1 Components of application windows.** All application windows should have a border or frame, a title bar, window controls, and a working area. [Source: DON UISNCCS, V1.2, 8.1]

  Discussion. Depending on the needs of the user, application windows may also contain a window menu bar, a command entry area, and a message area. [Source: DON UISNCCS, V1.2, 8.1]

- **8.15.3.2.2 Location of title bar.** The title bar shall extend across the top of the window. [Source: DON UISNCCS, V1.2, 8.1]

- **8.15.3.2.3 Location of title in window title bar.** The window title shall appear centered in the window title bar. [Source: DON UISNCCS, V1.2, 8.1.1]

- **8.15.3.2.4 Capitalization of title.** The window title shall be in mixed-case letters. [Source: Ameritech Services Inc., 1996 - 3.1.1.2.4]

- **8.15.3.2.5 Title content.** The title shall be as informative as possible, describing the purpose of the window and may also include the name of the application. [Source: DON UISNCCS, V1.2, 8.1.1]

- **8.15.3.2.6 Title of window based on option selection.** When a window is displayed as a result of the selection of an option in a menu, the title of the window shall be the same as the wording of the option. [Source: DON UISNCCS, V1.2, 8.1.1]

- **8.15.3.2.7 Location of window controls.** Window controls shall be located on the title bar with **Minimize, Restore/ Maximize,** and **Close** options at the right end and a control producing a menu of window management options on the left end. [Source: DON UISNCCS, V1.2, 4.1.1]

- **8.15.3.2.8 Location of menu bar.** When used, the menu bar shall extend across the window just below the title bar. [Source: DON UISNCCS, V1.2, 8.1]

- **8.15.3.2.9 Location of working area.** The working area shall occupy all the space inside the border that is not occupied by another component. [Source: DON UISNCCS, V1.2, 8.1]

- **8.15.3.2.10 Location of command entry area.** When used, the command entry area shall extend across the bottom of the window just above the message area. [Source: DON UISNCCS, V1.2, 8.1]

- **8.15.3.2.11 Location of message area.** When used, the message area shall extend across the bottom of the window. [Source: DON UISNCCS, V1.2, 8.1]

- **8.15.3.2.12 Application window behavior.** The user should be able to move and resize application windows. [Source: Microsoft Corp., 1992 - 4.1.1]

- **8.15.3.2.13 Operations in an application window.** Most application operations should take place within the application window, these may appear outside of the application window. The three exceptions are

  a. dialogs or drop-down menus in resized windows,

  b. movable dialog boxes, and

  c. the **Help** window. [Source: Microsoft Corp., 1992 - 4.1.1]

- **8.15.3.2.14 Switching windows.** The user should be able to use either the mouse or the keyboard to switch from one application window to another and from one secondary window to another within the same application. [Source: Microsoft Corp., 1992 - 4.3.5]

8.15.3.3 The system window

- **8.15.3.3.1 Appearance.** The system window shall appear when system startup is complete. [Source: DON UISNCCS, V1.2, 7.2.1]

- **8.15.3.3.2 System-window size.** The system window shall occupy the entire screen. [Source: DON UISNCCS, V1.2, 7.2.1]

- **8.15.3.3.3 System-window components.** All system windows shall have a border or frame, a title bar, window controls, and a working area. [Source: DON UISNCCS, V1.2, 7.2.1]

- **8.15.3.3.4 Location of title bar.** The system window shall contain a system title bar that extends across the top of the screen. [Source: DON UISNCCS, V1.2, 7.2.1]

- **8.15.3.3.5 Location of title.** The system-title bar shall contain a centered title that identifies the system. [Source: DON UISNCCS, V1.2, 7.2.1]

  Discussion. The system-title bar may also include optional components such as status indicators and a date and time display. [Source: DON UISNCCS, V1.2, 7.2.1]

- **8.15.3.3.6 Location of menu bar.** The system window shall contain a system-menu bar that extends across the screen located just below the system-title bar. [Source: DON UISNCCS, V1.2, 7.2.1]

- **8.15.3.3.7 Display area.** The system window shall contain an area available for the display of application windows that occupies the remainder of the screen. [Source: DON UISNCCS, V1.2, 7.2.1]

  Discussion. The application area of the system window may contain icons that represent application windows or action icons common to all applications. [Source: DON UISNCCS, V1.2, 7.2.1]

- **8.15.3.3.8 System window behavior.** Users should not be able to move or resize the system window nor shall they be able to obscure the system-title bar or system menu bar. [Source: DON UISNCCS, V1.2, 7.2.2]

8.15.3.4 Data-entry windows

This section covers information on the windows used for data entry. For specific information on data entry, see section 8.2.3, Data entry and editing.

- **8.15.3.4.1 Data-entry window elements.** A data-entry window should contain a title that describes the purpose or contents of the window, a set of labeled fields, vertical or horizontal scroll-bars or both if the contents do not fit in the window's working area, and controls appropriate to the task. [Source: DON UISNCCS, V1.2, 9.2.1]

  Definition. A **data-entry window** is a window that contains a set of labeled fields for entering, changing, and deleting data. It may also contain labeled data display fields, which a user cannot change. [Source: DON UISNCCS, V1.2, 9.2.1]

- **8.15.3.4.2 Data window organization.** The organization of a data-entry window should be consistent with the task it represents. [Source: DON UISNCCS, V1.2, 9.2.1]

  Example. Data fields are arranged by sequence of use, frequency of use, or importance with related fields grouped together and separated from unrelated fields. [Source: DON UISNCCS, V1.2, 9.2.1]

- **8.15.3.4.3 Multi-page data entry windows.** Every effort should be made to minimize the number of pages in data entry windows, particularly if the user is expected to change pages frequently while entering data. When the contents of a set of data-entry fields do not fit the window working area,

  a. the window should provide users the ability to page, scroll, or both, through the entire set; and

  b. if the fields are arranged in rows, columns, or both, the labels of the rows or columns should remain in place when the rows or columns scroll or page. [Source: DON UISNCCS, V1.2, 9.2.1]

- **8.15.3.4.4 Push buttons in data-entry windows.** When a data entry window contains push buttons, the buttons should be placed in a row at the bottom of the working area, visually separated from the data fields. [Source: DON UISNCCS, V1.2, 9.2.1]

- **8.15.3.4.5 Controls for data-entry windows.** A data entry window should contain the controls appropriate to the task. [Source: DON UISNCCS, V1.2, 9.2.1]

  Examples. When the contents require more than one page, the window would contain controls for paging. It might also be appropriate to include controls for clearing entries and restarting data entry. [Source: DON UISNCCS, V1.2, 9.2.1]

- **8.15.3.4.6 Saving entered data.** When a user has finished making entries in a data-entry window, he or she shall be able to save the entries by taking an explicit action such as selecting a **Save** menu option or activating an **Apply** or **OK** push button. [Source: DON UISNCCS, V1.2, 9.2.3]

8.15.3.5 Text windows

- **8.15.3.5.1 Width of a text window.** A window intended for the display of textual information should be wide enough to display an entire line of anticipated text without horizontal scrolling. [Source: DON UISNCCS, V1.2, 9.3.1]

- **8.15.3.5.2 Text window too small for entire document.** When an entire text document does not fit in the current window, the window shall have a vertical scroll-bar or a similar mechanism (positioned either on the right or left side of a window) so that users can view the entire document. [Source: DON UISNCCS, V1.2, 9.3.1]

8.15.3.6 Map windows

- **8.15.3.6.1 Map window elements.** A map window should include (1) a title; (2) identifying information such as coordinates, area, and scale; (3) the map itself; (4) a continuous coordinate indicator that states the pointer location; and (5) appropriate controls. [Source: DON UISNCCS, V1.2, 9.6.1]

8.15.3.7 Utility windows

- **8.15.3.7.1 Utility windows.** Utility windows should float on top of document windows. [Source: Apple Computer Inc., 1992 – p. 137]

  Definition. A **utility window** is a supplementary window that provides the users with additional tools or controls such as a tool palette or a set of text attributes.

8.15.4 Message windows

This section contains criteria and guidelines for several special purpose message windows (also called message boxes). These include dialog boxes, request windows, error-message windows, information-message windows, confirmation-message windows, warning-message windows, and working-message windows.

Definition/discussion. A **message window** (sometimes called a **message box**) is a secondary window that provides users with non-critical information, progress information about lengthy processes, alerts to unusual events, and/or warnings of potential dangers. Message windows may be modal or modeless.

8.15.4.1 General

- **8.15.4.1.1 Disallowed operations.** Users should not be able to **Minimize** or **Resize** message windows. [Source: DON UISNCCS, V1.2, 4.4.2.3]

- **8.15.4.1.2 Message windows.** Message windows should contain a title, a symbol that indicates the type of message, the message itself, and one or more push buttons. [Source: DON UISNCCS, V1.2, 8.2.2.1]

  Discussion. Some examples of possible symbols for different types of messages are: **i** for information messages; **?** for request and confirmation messages; **!** for warning messages; and a watch, clock, or hourglass for working messages. [Source: DON UISNCCS, V1.2, 8.2.2.1]

- **8.15.4.1.3 Message windows.** When covering underlying information is a problem, movable message windows should be used. [Source: Ameritech Services Inc., 1996 - 3.1.2.2.5.]

- **8.15.4.1.4 Message wording.** The messages in message windows should use language that is meaningful to users and should require no further documentation or translation. [Source: DON UISNCCS, V1.2, 8.2.2.1]

- **8.15.4.1.5 Message content.** Messages should focus on what needs to be done, not on what was done wrong. [Source: DON UISNCCS, V1.2, 8.2.2.1]

- **8.15.4.1.6 Message window size.** Message windows should be just large enough to display the information required. [Source: DON UISNCCS, V1.2, 8.2.2.1]

- **8.15.4.1.7 Message window location.** Message windows should be distinctive in appearance and be located in a standard location on the screen. [Source: DON UISNCCS, V1.2, 8.2.2.1]

8.15.4.2 Request message window

- **8.15.4.2.1 Request message window use.** A request message window should be used when it is necessary to request information from a user before processing can proceed. [Source: DON UISNCCS, V1.2, 8.2.1]

- **8.15.4.2.2 Request message window components.** A request message window should contain a title, a question symbol (**?**),a message indicating the information required and all of the following push buttons that apply in the order in which they are listed: **OK, Apply, Reset, Cancel,** and **Help**. [Source: DON UISNCCS, V1.2, 8.2.1].

  Discussion. A message window may also contain a text field.

8.15.4.3 Information message window

- **8.15.4.3.1 Information message window use.** An information message window should be used to convey non-critical information that requires acknowledgement. [Source: DON UISNCCS, V1.2, 8.2.2.3]

- **8.15.4.3.2 Information message windows.** Information message windows shall be modal and require acknowledgement. [Source: DON UISNCCS, V1.2, 8.2.2.3]

- **8.15.4.3.3 Information message window components.** An information message window should contain an information symbol (**i**), a message, and the following push buttons below the message in the order listed: **OK** and **Help**. [Source: DON UISNCCS, V1.2, 8.2.2.3]

  Discussion. The message area described in paragraph 8.15.3.1.3 is different than this information message window; the message area is for messages that do not require acknowledgement. [Source: DON UISNCCS, V1.2, 8.2.2.3]

- **8.15.4.3.4 Information message window behavior.** Information message windows shall not appear to the user to interrupt processing by the application.

  Discussion. If the application interrupts processing, make sure that it is transparent to the user. [Source: DON UISNCCS, V1.2, 8.2.2.3]

8.15.4.4 Confirmation message window

- **8.15.4.4.1 Confirmation message window use.** Confirmation message windows should be used to request clarification of a previous user action. [Source: DON UISNCCS, V1.2, 8.2.2.4]

- **8.15.4.4.2 Requiring user response.** The application should suspend processing until the user responds to a confirmation message window. [Source: DON UISNCCS, V1.2, 8.2.2.4]

- **8.15.4.4.3 Confirmation message window components.** Confirmation message windows should contain a question symbol (**?**), a message, and one of the following sets of push buttons below the message in the order listed: {**Yes**, **No,** and **Help**} or {**Yes, No, Cancel**, and **Help**}. [Source: DON UISNCCS, V1.2, 8.2.2.4]

8.15.4.5 Warning message window

- **8.15.4.5.1 Warning message window use.** Critical messages warning users of destructive consequences of actions should be displayed in warning message windows. [Source: DON UISNCCS, V1.2, 8.2.2.5]

- **8.15.4.5.2 Suspending processing.** When a warning message window appears, processing should be suspended until a user responds to the message. [Source: DON UISNCCS, V1.2, 8.2.2.5]

- **8.15.4.5.3 Warning message window contents.** Warning message windows should contain a warning symbol **(!)**, a message, and one of the following sets of push buttons below the message in the order listed: {**Yes, No,** and **Help}** or {**OK, Cancel,** and **Help}**. [Source: Ameritech Services Inc., 1996 - 3.1.2.1.2; DON UISNCCS, V1.2, 8.2.2.5]

- **8.15.4.5.4 Accompanying audible warning signals.** Warning messages should be accompanied by an audible signal. [Source: DON UISNCCS, V1.2, 8.2.2.5]

  Discussion. An auditory beep indicating the nature of the error may be considered based upon the criticality of the error and the logic of the integrated alarm system, if present.

8.15.4.6 Working message window

- **8.15.4.6.1 Working message window use.** When the processing time resulting from a user action will exceed 2 seconds, the system shall display a working message window. [Source: DON UISNCCS, V1.2, 8.2.2.6]

- **8.15.4.6.2 Working message windows.** The display of a working message window shall not interrupt processing. [Source: DON UISNCCS, V1.2, 8.2.2.6]

- **8.15.4.6.3 Working message window display.** The working message window shall remain on display until processing is completed or until the user minimizes the window or cancels the process. [Source: DON UISNCCS, V1.2, 8.2.2.6]

- **8.15.4.6.4 Working message window removal.** The window shall be removed automatically when processing is completed. [Source: DON UISNCCS, V1.2, 8.2.2.6]
- **8.15.4.6.5 Working message window contents.** Working message windows shall contain a working symbol, a message, and one of the following sets of push buttons below the message, in the order listed: {**OK** and **Help**}, {**OK, Cancel,** and **Help**}, {**OK, Stop,** and **Help**}, or {**OK, Pause, Resume, Stop,** and **Help**}. [Source: DON UISNCCS, V1.2, 8.2.2.6]

- **8.15.4.6.6 Progressive working windows.** When processing time will be lengthy, the window should be updated to indicate the status of processing (e.g., percent complete or time remaining) or should include a scale showing the proportion of processing completed. [Source: DON UISNCCS, V1.2, 8.2.2.6]

8.15.4.7 Dialog boxes

Dialog boxes may be movable or fixed, of a single size or two alternate sizes, modal (requiring a response before continuing), semi-modal, or modeless, and may present limited response options or more complex options. [Source: Microsoft Corp., 1992 - 7.1]

- **8.15.4.7.1 Modeless dialog boxes.** Modeless dialog boxes should be used for getting user input and for making changes to a document. [Source: Apple Computer Inc., 1992 – pp. 176]

- **8.15.4.7.2 Modal dialog boxes.** Modal dialog boxes should be used to make the user give necessary information before carrying out the current operation. [Source: Apple Computer Inc., 1992 – pp. 176 and 193]

- **8.15.4.7.3 Movable modal dialog boxes.** Movable modal dialog boxes should be used when input is needed from the user and for making changes to a document while allowing the user to switch to another application. [Source: Apple Computer Inc., 1992 – pp. 176 and 193]

- **8.15.4.7.4 Dialog boxes (control windows).** Sets of controls that perform similar or related functions should be grouped and presented together in a dialog box (also called a control window). [Source: DON UISNCCS, V1.2, 8.1.3.1]

- **8.15.4.7.5 Format.** A dialog box should have a border and a title that clearly indicates the function of the set of controls. [Source: DON UISNCCS, V1.2, 8.1.3.1]

- **8.15.4.7.6 Unavailable controls.** When a control is temporarily unavailable, it should be displayed at reduced intensity. [Source: DON UISNCCS, V1.2, 8.1.3.1]

- **8.15.4.7.7 Push buttons for control functions.** Each function of a dialog box should have a push button. [Source: CTA, 1996 - 3.10.1.2]

- **8.15.4.7.8 Size of control windows.** Control windows should be smaller than application windows. [Source: CTA, 1996 - 3.10.1.3]

- **8.15.4.7.9 Visibility of control windows.** Control windows (dialog boxes), when activated, should be visible on a primary display. [Source: Ameritech Services Inc., 1996 – 3.1.2.2.5]

- **8.15.4.7.10 Dialogs covering underlying information.** When covering underlying information is a problem, the application should use movable dialog boxes. [Source: Ameritech Services Inc., 1996 – 3.1.2.2.5]

- **8.15.4.7.11 Movable dialog box format.** A movable dialog box should contain a title bar consisting of a control menu and a title. [Source: Microsoft Corp., 1992 - 7.1.1]

- **8.15.4.7.12 Fixed dialog box format.** A dialog box that is immovable should not contain a title bar. [Source: Microsoft Corp., 1992 - 7.1.1]

- **8.15.4.7.13 Use of fixed vs. movable dialog boxes.** An application should primarily use movable dialog boxes; the user can reposition these to view obscured data. [Source: Microsoft Corp., 1992 - 7.1.1]

- **8.15.4.7.14 Alert box use.** Alert boxes (a type of modal dialog box) should be used for communicating error conditions or preventing any other activity until the user responds to the error condition. [Source: Apple Computer Inc., 1992 – pp. 193 and 194]

  Discussion. Alert boxes are applied to display messages to users to inform them of situations that may require their attention or are possibly dangerous. [Source: Apple Computer Inc., 1992 – p. 193]

- **8.15.4.7.15 Indication of alert severity.** An icon should be provided within the alert box that indicates the degree of severity of the alert message. [Source: Apple Computer Inc., 1992 – pp. 193 and 194]

8.15.4.8 Error dialog box

- **8.15.4.8.1 Error dialog box components.** An error message window should contain an error symbol, a message, and the following push buttons below the message in the order listed: **OK, Cancel,** and **Help**. [Source: DON UISNCCS, V1.2, 8.2.2.2]

- **8.15.4.8.2 Error dialog box modality.** Error windows shall be modal, requiring user acknowledgement in order to continue [Source: Ameritech Services Inc., 1996 - 3.1.2.1.2]

  Discussion. An accompanying auditory alert indicating the nature of the error may be considered if warranted by the criticality of the error and the logic of the system. [Source: Ameritech Services Inc., 1996 - 3.1.2.1.2]

- **8.15.4.8.3 Use of an error dialog box.** When an error is detected in a system that uses windows, a dialog box should appear that specifies the error. [Source: Ameritech Services Inc., 1996 - 5.3.2.2]

- **8.15.4.8.4 Placement of error dialog box.** An error dialog box should not be placed in front of the error. [Source: Ameritech Services Inc., 1996 - 5.3.2.2]

- **8.15.4.8.5 Error acknowledgement.** After the user acknowledges the error, the dialog box should disappear and the actual field that contains the error should be highlighted. [Source: Ameritech Services Inc., 1996 - 5.3.2.2]

8.15.5 Window states

8.15.5.1 Open windows

- **8.15.5.1.1 Input from system.** An open window shall be capable of receiving input from the system. [Source: DON UISNCCS, V1.2, 4.2.1]

- **8.15.5.1.2 Input from user.** A window that is open and active shall be capable of receiving input from a user. [Source: DON UISNCCS, V1.2, 4.2.1]

- **8.15.5.1.3 Visibility.** An open window shall be completely visible on the screen at the time it is opened and when it is active. [Source: DON UISNCCS, V1.2, 4.2.1]

  Discussion. More than one window can be opened on a screen at the same time. An open window may be partially or totally obscured by another open window, that is, an open window may or may not be visible. [Source: DON UISNCCS, V1.2, 4.2.1]

8.15.5.2 Closed windows

- **8.15.5.2.1 Closed window.** A closed window shall have no appearance on the screen, either as a window or as an icon. [Source: DON UISNCCS, V1.2, 4.2.4]

- **8.15.5.2.2 Closing a primary window.** When a primary window is closed, it and any of its secondary windows shall be removed from the screen. [Source: DON UISNCCS, V1.2, 4.2.4]

- **8.15.5.2.3 Reassigning input focus from closed window.** When a window that was closed had input focus, the user shall explicitly select another window to have focus instead of having the application arbitrarily assign focus to another window on the screen unless emergency action is required. [Source: DON UISNCCS, V1.2, 4.2.4]

- **8.15.5.2.4 Closing a secondary window.** When a secondary window is closed, it and any of its secondary windows should be removed from the screen without affecting the parent window except for the disappearance of the secondary window. [Source: DON UISNCCS, V1.2, 4.4.2.1]

8.15.5.3 Active window

- **8.15.5.3.1 Making a window active.** A window shall be made active by clicking anywhere inside the window frame or picking it from the window menu. [Source: Ameritech Services Inc., 1996 - 3.1.1.4.1]

  Discussion. The active window is the one with which the user is working at any time; it has input focus. [Source: DON UISNCCS, V1.2, 4.2.2]

- **8.15.5.3.2 Active windows.** Only one window at a time shall be active. [Source: DON UISNCCS, V1.2, 4.2.2]

- **8.15.5.3.3 Visibility of active window.** The active window shall not be obscured by any other window or icon. [Source: DON UISNCCS, V1.2, 4.2.2]

- **8.15.5.3.4 Active window.** When more than one window is selected and opened, the last window activated should be designated as the active window. [Source: National Air Traffic Services, 1999 - 1.10.2.6.3.1.1]

- **8.15.5.3.5 Overlapping windows.** When windows are allowed to overlap, the active window should be in front of and not overlapped by other windows. [Source: National Air Traffic Services, 1999 - 1.10.2.6.3.1.1]

- **8.15.5.3.6 Location upon activation.** When a window is activated, it should appear in front of any other window that is currently open. [Source: National Air Traffic Services, 1999 - 1.10.2.6.3.1.1]

- **8.15.5.3.7 Distinguishing active windows.** An active window shall be distinguishable from inactive windows. [Source: DON UISNCCS, V1.2, 4.2.2]

  Exception. Complex situations may occur where one window has input focus for keyboard and mouse inputs and another window has input for voice entries. [Source: DON UISNCCS, V1.2, 4.2.2]

- **8.15.5.3.8 Making a window active.** When a window is made active, all other windows shall be made inactive, although there may still be operations (e.g., background processing) occurring in the inactive windows. [Source: Ameritech Services Inc., 1996 - 3.1.1.4.1]

  Discussion. An inactive window continues to be displayed on the screen but may be obscured by other windows. [Source: DON UISNCCS, V1.2, 4.2.2]

- **8.15.5.3.9 When a window becomes inactive.** When a window becomes inactive, it shall cause selections to be deselected, the title bar to become inoperative, and the other window elements to disappear or change appearance (e.g., supplemental windows or floating palettes). [Source: Ameritech Services Inc., 1996 - 3.1.1.4.1]

- **8.15.5.3.10 Effect of reactivating window on selections.** When a window is reactivated, it should not have an affect on any pre-existing selection. [Source: Microsoft Corp., 1992 - 4.3.5]

- **8.15.5.3.11 State of reactivated window.** Upon reactivation, a window should be restored to the state that it was in when it was last activated. [Source: Microsoft Corp., 1992 - 4.3.5]

  Example. When a window is activated, the title bar will become operative, the window and its contents visible, and all window elements will appear. Anything deselected when the window was made inactive will be selected again.

8.15.5.4 Input focus

- **8.15.5.4.1 One input focus.** Regardless of the number of windows open in an application, only one window at a time (the active window) shall be able to receive input from a pointing device or the keyboard. [Source: DON UISNCCS, V1.2, 3.1.1]

  Definition. Input focus is the notion that only one window and usually only one object in a window at a time is capable of accepting input from a pointing device or the keyboard. Input focus can be explicit (the user must move the pointer into the window and click the appropriate mouse button) or implicit (the user must only move the pointer into the window). [Source: Ameritech Services Inc., 1996 - 3.1.1.4.1]

- **8.15.5.4.2 User assignable input focus.** Users shall be able to assign input focus to any open window of the current application either with a pointing device or from the keyboard. [Source: DON UISNCCS, V1.2, 3.1.1]

- **8.15.5.4.3 Assigning input focus with a pointing device.** Users shall be able to assign input focus to any window that is wholly or partially visible by moving the pointer onto any visible portion (and clicking the appropriate button where explicit input focus is necessary). [Source: DON UISNCCS, V1.2, 3.1.2]

- **8.15.5.4.4 Window with input focus.** When any portion of a window was obscured by another window, upon activation, the window with input focus shall be made wholly visible. [Source: DON UISNCCS, V1.2, 3.1.2]

- **8.15.5.4.5 Moving input focus using the keyboard.** Users shall be able to press a single key or specific key combinations to move the input focus forward or backward through the open windows one window at a time in the order in which they were opened. [Source: DON UISNCCS, V1.2, 3.1.3]

- **8.15.5.4.6 Single object focus.** Only one object in the window having input focus shall be able to receive input from a pointing device or the keyboard. [Source: DON UISNCCS, V1.2, 3.3]

- **8.15.5.4.7 Indicating the object having input focus.** When an object has input focus, that object shall be indicated with a location cursor or highlighting. [Source: DON UISNCCS, V1.2, 3.3]

- **8.15.5.4.8 Location of input focus in a window.** When a window first appears, the location cursor or highlighting shall be placed on the object that users are most likely to select, for example, a text field or a default push button. [Source: DON UISNCCS, V1.2, 2.3.1, 3.3]

- **8.15.5.4.9 Windows regaining input focus.** When a window has lost and then regained input focus, the location cursor or highlighting shall be placed on the object that last had input focus in the window. [Source: DON UISNCCS, V1.2, 2.3.1, 3.3]

- **8.15.5.4.10 Moving input focus.** A user shall be able to move the input focus among objects in the window using either the pointing device or the keyboard. [Source: DON UISNCCS, V1.2, 2.3.1, 3.3]

- **8.15.5.4.11 Assigning input focus to an object.** Users shall be able to assign input focus to an object within a window using either the pointing device or the keyboard. [Source: DON UISNCCS, V1.2, 3.3]

- **8.15.5.4.12 Moving input focus to an object with a pointing device.** Users shall be able to move input focus among objects within a window by moving the pointer onto an object (and clicking the appropriate button where explicit input focus is necessary). [Source: DON UISNCCS, V1.2, 2.3.1, 3.3.1]

8.15.6 Window operations

For each system or application, the window operations that are performed need to be identified and their manner of execution made consistent throughout the system.

8.15.6.1 Splitting windows

- **8.15.6.1.1 Where to split a window.** Window split capabilities shall be provided that allow the user to divide the window into panes at any location along the scroll-bar. [Source: Ameritech Services Inc., 1996 - 3.1.1.3.1, 3.1.1.3.2, and 3.1.1.3.3]

  Example. A window can be split allowing a user to see two parts of a spreadsheet or document at the same time. [Source: Microsoft Corp., 1992 - 4.2.5]

- **8.15.6.1.2 Different views.** A split window should allow the user to display different views of the same information such as print view and outline view. [Source: Microsoft Corp., 1992 - 4.2.5]

- **8.15.6.1.3 Splitting a window.** The user should be able to split the application window into two or more separate viewing areas called panes. [Source: Microsoft Corp., 1992 - 4.2.5]

  Definition. The separate viewing areas in a split window are called **panes**. [Source: Microsoft Corp., 1992 - 4.2.5]

- **8.15.6.1.4 Number of panes.** The user should be allowed to split the window into as many panes as is useful and practical. [Source: Microsoft Corp., 1992 - 4.2.5]

- **8.15.6.1.5 Windows with panes.** All panes in a window should be kept within the window. [Source: Microsoft Corp., 1992 - 4.2.5]

- **8.15.6.1.6 Manipulating windowpanes.** Each pane of a split window shall be independent in its manipulation. [Source: Ameritech Services Inc., 1996 - 3.1.1.3.3]

- **8.15.6.1.7 Split box.** For all windows that are capable of being split, applications should provide a split box. [Source: Microsoft Corp., 1992 - 4.2.5]

  Definition. A **split bar** is the divider placed across the middle of the window that separates the panes. A **split box** is a rectangular indicator located inside the scroll-bar of a split window or immediately above the scroll-bar of a split-able window. Note however, that in some guidelines, the split box is called the split bar. [Source: Microsoft Corp., 1992 - 4.2.5]

- **8.15.6.1.8 Using a split box to split a window.** The user should be able to drag the split box to a location in the scroll-bar where the new pane is to begin. [Source: Apple Computer Inc., 1992 – p. 170]

- ▫ **8.15.6.1.9 Moving a split bar.** A user should be able to move a split bar up or down by pressing the arrow keys. [Source: Microsoft Corp., 1992 - 4.3.4]

- ▫ **8.15.6.1.10 Scroll-bars for split windows.** When a window is split, scroll-bars should be displayed on the panes perpendicular to the direction of the split. [Source: Microsoft Corp., 1992 - 4.2.5]

- ▪ **8.15.6.1.11 Separate scroll-bars.** After a window is split, separate scroll-bars shall appear on either side of the split bar or split box. [Source: Ameritech Services Inc., 1996 - 3.1.1.3.3]

8.15.6.2 Minimizing windows

- ▪ **8.15.6.2.1 Minimize window.** When a user minimizes an open window, the window and any open secondary windows shall be replaced by the window's icon. [Source: DON UISNCCS, V1.2, 4.2.3]

- ▫ **8.15.6.2.2 Uniqueness of icons representing minimized windows.** Any window that can be **minimized** should have a unique icon or label that serves as an identifier of the window it represents. [Source: Ameritech Services Inc., 1996 - 3.1.1.3.2; Open Look GUIASG, p. 71]

  > **Definition.** A **minimize** operation reduces a windows presence into a standby icon button on the information line at the bottom of the screen. **Iconize** or **Iconify** are older and potentially confusing terms for the minimize operation because icons are widely used beyond representing a minimized active window. [Source: Ameritech Services Inc., 1996 - 3.1.1.3.2; Open Look GUIASG, p. 71]

- ▫ **8.15.6.2.3 Processes occurring in minimized windows.** Any processing occurring in a window should continue after the window is minimized. [Source: DON UISNCCS, V1.2, 4.2.3]

- ▪ **8.15.6.2.4 Minimize operation.** Where applicable, the application shall provide a minimize operation that changes a window into an icon button at the bottom of the screen. [Source: DON UISNCCS, V1.2, 4.1.2]

- ▪ **8.15.6.2.5 Minimizing a window using a pointing device.** When a window can be minimized, a user shall be able to minimize the window by moving the pointer onto the **Minimize** control in the title bar and clicking the appropriate button or by selecting **Minimize** from the window menu or control menu. [Source: DON UISNCCS, V1.2, 4.3.1.4]

- ▪ **8.15.6.2.6 Minimizing a window using the keyboard.** When a window can be minimized, a user shall be able to minimize the window using the keyboard by selecting **Minimize** from the window menu. [Source: Ameritech Services Inc., 1996 - 3.1.1.3.2]

- **8.15.6.2.7 Minimized window menu.** A minimized window shall have a menu that contains the same options as its window system menu with the exceptions of the **Resize** and **Minimize** options. (When a window menu includes **Resize** and **Minimize** options, these options shall appear on the menu as unavailable.) [Source: DON UISNCCS, V1.2, 4.5]

- **8.15.6.2.8 Selecting options from a minimized window menu.** A user shall select a minimized window menu item using standard option selection methods. [Source: DON UISNCCS, V1.2, 4.5]

- **8.15.6.2.9 Removing minimized window menu.** A user shall be able to remove a minimized window menu by moving the pointer off the menu and clicking the appropriate button. [Source: DON UISNCCS, V1.2, 4.5]

- **8.15.6.2.10 Location of minimized windows.** Unless specified otherwise by the application, the icons representing minimized windows shall be placed in the lower left corner of the screen, arrayed in a row from left to right in the order in which they are created. [Source: DON UISNCCS, V1.2, 4.5]

8.15.6.3 Maximizing windows

- **8.15.6.3.1 Maximizing a window.** When the user clicks on the **maximize** button, the application shall enlarge the window to its largest size or to encompass the entire display screen, which ever is smaller. [Source: Ameritech Services Inc., 1996 - 3.1.1.3.2 and 3.1.1.3.3]

- **8.15.6.3.2 Maximize button on maximized windows.** When a window is maximized, the **Maximize** button shall assume a **Restore** function and the button shall take on the **Restore** icon and function. [Source: Ameritech Services Inc., 1996 - 3.1.1.3.2 and 3.1.1.3.3]

- **8.15.6.3.3 Maximize.** When the window can be resized, the application shall provide a **Maximize** operation that enlarges a window to its maximum size. [Source: DON UISNCCS, V1.2, 4.1.2]

8.15.6.4 Restoring windows

- **8.15.6.4.1 The restore function.** A click on the **Restore** button shall change the window and any associated secondary windows to the size and location where they had been prior to last being maximized or minimized. [Source: DON UISNCCS, V1.2, 4.3.1.4]

- **8.15.6.4.2 Status of restored window.** A restored window shall have active status. [Source: Ameritech Services Inc., 1996 - 3.1.1.3.2; DON UISNCCS, V1.2, 4.3.1.4]

- **8.15.6.4.3 Restoring the window.** A user shall be able to restore a window and any secondary windows that were displayed when the window was minimized. This was done by moving the pointer and clicking on the icon representing the minimized window or displaying the menu of the minimized window and selecting **Restore**. [Source: DON UISNCCS, V1.2, 4.5]

- **8.15.6.4.4 Equivalence of input device.** It shall be possible to restore a minimized window by either using the pointing device or by using the keyboard. [Source: DON UISNCCS, V1.2, 4.3.1.4]

- **8.15.6.4.5 Restoring window to default size.** Where applicable, the application shall provide a **Restore** operation that enables a user to restore a minimized or maximized window to its default size. [Source: DON UISNCCS, V1.2, 4.1.2]

- **8.15.6.4.6 Restore option on full sized windows.** The **Restore** option shall be unavailable when the window is its default size. [Source: DON UISNCCS, V1.2, 4.1.2]

8.15.6.5 Closing windows

- **8.15.6.5.1 Closing the window.** A user shall be able to close a window and any secondary windows associated with the window by moving the pointer and clicking on the **Close** control or displaying the menu of the minimized window and selecting **Close**. [Source: DON UISNCCS, V1.2, 4.5 and DON UISNCCS, V1.2, 4.1.2]

- **8.15.6.5.2 Close.** When the window can be closed, the application shall provide a **Close** operation that enables a user to close a window, that is, to remove it from the screen and stop processing operations associated with the window. [Source: DON UISNCCS, V1.2, 4.1.2]

- **8.15.6.5.3 Confirming Close.** When processing is occurring or when unsaved data have been generated in the window, users shall be required to confirm the **Close** action before the window is removed from the screen and processing stops. [Source: DON UISNCCS, V1.2, 4.1.2]

8.15.6.6 Moving windows

- **8.15.6.6.1 Move capability.** Where applicable, the application shall provide a **Move** operation that enables a user to move a window on the screen. [Source: DON UISNCCS, V1.2, 4.1.2]

- **8.15.6.6.2 Movement without activation.** The application should permit the user to move a window without making the window active. [Source: National Air Traffic Services, 1999 - 1.10.2.4.2.6.1]

  Discussion. In some applications, users are not able to move all windows. For example, some windows are only advisory in nature, such as the amount of processing time remaining. These types of windows cannot be moved, closed, minimized to icon size, or resized by the user.

- **8.15.6.6.3 Moving a window with a pointing device.** When a window is movable and a pointing device is available, a user shall be able to move the window by moving the pointer into the window title bar, pressing the appropriate button on the pointing device, and dragging the window to its new location. [Source: DON UISNCCS, V1.2, 4.3.1.2]

  Discussion. As the user moves the pointing device the window or an outline of the window will move on the screen resulting in the display of the window in the new location when the button is released.

- **8.15.6.6.4 Window movement limits**. The user shall never be able to move a window off the display so that it cannot be seen, although it may be completely hidden by one or more other windows. [Source: Ameritech Services Inc., 1996 - 3.1.1.5.2]

8.15.6.7 Resizing windows

- **8.15.6.7.1 Resize.** Where applicable, the application shall provide a **Resize** operation that enables a user to change the size of a window. [Source: DON UISNCCS, V1.2, 4.1.2]

- **8.15.6.7.2 Moved or resized windows.** When a window has been moved or resized or both and is then closed and reopened during an application session, it shall reappear in the size and location it had when it was closed. [Source: DON UISNCCS, V1.2, 4.3.1.1]

- **8.15.6.7.3 Default location for moved or resized windows.** When a window has been moved or resized in the current session, it shall appear in its default location at the next application session. [Source: DON UISNCCS, V1.2, 4.3.1.1]

- **8.15.6.7.4 Obscuring critical information.** Critical information shall not be obscured during window resizing. [Source: CTA, 1996 – 6.3.1.1.4]

- **8.15.6.7.5 Resizing a window using a pointing device.** When a pointing device is available, a user shall be able to resize a resizable window by (1) moving the pointer onto the window's border, (2) pressing and holding the appropriate button on the pointing device, (3) dragging the border to the desired position, and (4) releasing the button resulting in the window being displayed in its new size. [Source: DON UISNCCS, V1.2, 4.3.1.2]

- **8.15.6.7.6 Changing window using a pointer.** When dragging the border of a window, the window itself or an outline of the window shall move with the pointer, indicating the changing size of the window, while leaving the window displayed in its original position. [Source: National Air Traffic Services, 1999 - 1.10.2.4.2.7.5]

- **8.15.6.7.7 Resizing in one direction.** Resizing a window by placing the pointer onto an edge of the window (top, bottom, or sides) shall permit changing its size in one direction only. [Source: DON UISNCCS, V1.2, 4.3.1.2]

- **8.15.6.7.8 Resizing in two directions.** Resizing a window by placing the pointer onto a corner shall permit changing the size of a window in two directions at once. [Source: DON UISNCCS, V1.2, 4.3.1.2]

- **8.15.6.7.9 Standard sizing buttons.** Standard buttons should be provided by which the user may control the size of the window (from minimum through variable to maximum) [Source: CTA, 1996 – 6.2.1.3.1]

- **8.15.6.7.10 Reformatting of text, graphics and icons.** Upon resizing of a window, text, graphics, or icon layouts should reformat so that they remain visible. [Source: CTA, 1996 – 6.3.1.1.3].

- **8.15.6.7.11 Only borders affected.** When a user resizes a window, only the border(s) affected should move, not the objects within the borders. [Source: DON UISNCCS, V1.2, 8.6.3]

- **8.15.6.7.12 Proportional image size change.** When the size of a window changes but the content remains the same, the image size should change proportionately as the window size changes [Source: National Air Traffic Services, 1999 - 1.10.2.4.2.7.6]

- **8.15.6.7.13 Scroll bars.** When a window becomes too small to display its objects, vertical or horizontal scroll-bars or both should be added. [Source: DON UISNCCS, V1.2, 8.6.3]

  Discussion. When appropriate, the size to which a window can be reduced may be restricted so that its objects cannot be obscured. [Source: DON UISNCCS, V1.2, 8.6.3]

8.15.6.8 Operations in windows

- **8.15.6.8.1 Moving and copying objects.** Users should be able to perform the following operations on objects in a window. These operations are

  a. to move an object to another location in the same window,

  b. to move an object to a different window,

  c. to copy an object and place the copy at a different location in the same window,

  d. to copy an object and place the copy in a different window. [Source: DONUISNCCS, V1.2, 3.5]

8.15.7 Window navigation

8.15.7.1 General

- **8.15.7.1.1 Software navigation aids.** The user should be able to switch between software modules in a quick, easy manner using an interface such as a tree or organization chart. This function should include the ability to select a menu or submenu directly, without going through intermediate steps. [Source: DOE HFDG ATCCS, V2.0, 5.3.4.4]

- **8.15.7.1.2 Open window map.** When using an overlapping window structure, applications should provide a user-requested iconic or text map indication of all open windows to allow the user to easily identify all open (especially hidden) windows. [Source: DOE HFDG ATCCS, V2.0, 7.5.2]

- **8.15.7.1.3 Suitability/appropriateness of overlapping windows.** An overlapping window format should be used in cases where

  a. the task requires variable or unconstrained types, sizes, numbers, contents and/or arrangement of windows;

  b. the visual display is small or such low resolution that users cannot view meaningful amounts of information in individual tiled windows;

  c. user activities cut across independent tasks;

  d. tasks require frequent window manipulation; and

  e. users are expert or use the application frequently. [Source: National Air Traffic Services, 1999 - 1.10.2.3.4.1]

- **8.15.7.1.4 Overlapping windows.** Overlapping windows should not cover needed, underlying, screen information; the underlying screen title; or navigation controls that may be needed. [Source: National Air Traffic Services, 1999 - 1.10.2.3.4.2]

- **8.15.7.1.5 Destructive overlays.** Window overlays shall be nondestructive. [Source: National Air Traffic Services, 1999 - 1.10.2.3.4.2]

- **8.15.7.1.6 Overlaid data.** Overlaid data shall not be permanently erased. [Source: National Air Traffic Services, 1999 - 1.10.2.3.4.2]

- **8.15.7.1.7 Background patterns.** When windows overlap, neutral background patterns should be used instead of complex background patterns because the complex patterns may create unwanted visual effects. [Source: National Air Traffic Services, 1999 - 1.10.2.3.4.6]

- **8.15.7.1.8 Active designation from open window map.** Users should be given the capability to designate the active window through the iconic or text open window map by highlighting the window representation. [Source: DOE HFDG ATCCS, V2.0, 7.5.2]

- **8.15.7.1.9 Expanded window explanation of open window map.** When possible, the user should be able to query an open window map for expanded information (e.g., the date it was created, its size, or a description of the subject or application) on the file or application operating in the window. [Source: DOE HFDG ATCCS, V2.0, 7.5.3]

- **8.15.7.1.10 Window forward function with window map.** When an iconic or text map is provided for determining the numbers and names of open windows in an overlapping system, the user should be able to bring a window forward from the map without having to resize or move other windows. [Source: DOE HFDG ATCCS, V2.0, 7.5.4]

8.16 Audio and verbal displays

This section presents general criteria and guidelines for audio displays, verbal warning signals, and auditory coding.

8.16.1 Audio displays

8.16.1.1 General

- **8.16.1.1.1 General.** Audio signals should be provided, as necessary, to warn personnel of impending danger, alert a user to a critical change in system or equipment status, and to remind a user of critical actions that must be taken. [Source: MIL-STD-1472F, 5.3.2.1]

- **8.16.1.1.2 When to use.** An audio signal should be provided when any of the following conditions apply.

  a. The information to be processed is short, simple, transitory, and requires immediate or time-based response.

  b. The use of a visual display might be inappropriate because of overburdening of the visual modality, ambient light variability or limitation, user mobility, degradation of vision by vibration, other environmental considerations, or anticipated user inattention.

  c. The criticality of a response to a visual signal makes supplementary or redundant alerting desirable.

  d. It is desirable to warn, alert, or cue the user for subsequent or additional responses.

  e. Custom or usage has created anticipation of an audio display.

  f. Voice communication is necessary or desirable. [Source: MIL-STD-1472F, 5.3.1.1]

- **8.16.1.1.3 Redundant visual warning.** All nonverbal audio signals shall be accompanied by a visual signal that defines the condition. [Source: MIL-STD-1472F, 5.3.4.3.1]

- **8.16.1.1.4 Relation to visual displays.** When used in conjunction with a visual display, an audio signal shall be supplementary or supportive, alerting and directing the user's attention to the appropriate visual display. [Source: MIL-STD-1472F, 5.3.2.4]

- **8.16.1.1.5 Signal type.** When an audio signal is used, the particular type of signal (tone, complex sound, or speech) should be the best for the intended use as indicated in Exhibit 8.16.1.1.5. [Source: MIL-STD-1472F, 5.3.1.2]

Exhibit 8.16.1.1.5 Characteristics and ratings of audio signals for various uses.

Use	Tones (periodic)	Complex Sounds (non periodic)	Speech
Quantitative indication	**(Poor)** Maximum of 5 to 6 tones absolutely recognizable.	**(Poor)** Interpolation between signals inaccurate.	**(Good)** Minimum time and error in obtaining exact value in terms compatible with response
Qualitative indication	**(Poor to fair)** Difficult to judge approximate value and direction of deviation from null setting unless presented in close temporal sequence.	**(Poor)** Difficult to judge approximate deviation from desired value.	**(Good)** Information concerning displacement direction, and rate presented in form compatible with required response.
Status indication	**(Good)** Start and stop timing; continuous information if rate of change of input is low.	**(Good)** Especially suitable for irregularly occurring signals, such as alarms.	**(Poor)** Inefficient; more easily masked; problem of repeatability.
Tracking	**(Fair)** Null position easily monitored; problem of signal-response compatibility	**(Poor)** Required qualitative indications difficult to provide.	**(Good)** Meaning intrinsic in signal.
General	Good for automatic communication of limited information; must be learned; easily generated.	Some sounds available with common meaning, (e.g., a fire bell); easily generated.	Most effective for rapid, but not automatic, communication or complex, multidimensional information; meaning intrinsic in signal and context, if standardized, minimum learning required

- **8.16.1.1.6 Alerting and warning system.** An alerting and warning system or signal shall provide the user with a greater probability of detecting the triggering condition than his or her normal observation would provide in the absence of the alerting or warning system or signal. [Source: MIL-STD-1472F, 5.3.2.1]

- **8.16.1.1.7 Use of auditory signals.** Auditory signals shall only be used when such signals contribute to understanding of and appropriate responses to the operational and task environment. [Source: Ameritech Services Inc., 1996 - 3.3.2.1]

- **8.16.1.1.8 Auditory signals.** Auditory signals shall not result in user or operator confusion, errors, or inefficiencies in response. [Source: Ameritech Services Inc., 1996 - 3.3.2.1]

- **8.16.1.1.9 User evaluation of alarms.** Auditory signals shall be tested and evaluated for usability, operational suitability, and user acceptance using representative users in as near to a realistic operational environment as possible before the signals are incorporated into a system. [Source: Ameritech Services Inc., 1996 - 3.3.2.1]

  Discussion. All auditory signals including verbal signals act as symbols that users must learn and interpret in the light of their operational and task environment. When designers overuse sound, the auditory signals often are ignored and can cause annoyance, interference, or confusion for the system users.

- **8.16.1.1.10 User setting of alarm parameters.** When appropriate to the task, a system or application should allow a user to set the parameter or condition that results in a software-generated alarm, alert, or status message. [Source: DOE HFDG ATCCS, V2.0, 2.6.4; MIL-HDBK-761A, 5.1.1.11.a]

  Example and discussion. Some examples of parameters or conditions are priorities, percentages, and absolute values or ranges of values. When multiple users are involved with a system, it may be the supervisors who determine the alarm parameters, not the individual users.

- **8.16.1.1.11 When users should not set alarm parameters.** User setting of parameters should not be allowed when (1) the settings by one user might affect the reception of alarms by another user; (2) the settings might affect the safety of systems, equipment, or personnel; or (3) alarm parameters are determined by functional, procedural, or legal requirements. [Source: DOE HFDG ATCCS, V2.0, 2.6.4; MIL-HDBK-761A, 5.1.1.11.a]

- **8.16.1.1.12 Attention.** Signals with high alerting capacities should be provided when the system or equipment imposes a requirement on the user for concentration of attention. [Source: MIL-STD-1472F, 5.3.4.2.1]

- **8.16.1.1.13 Startle.** Signals should not be so startling that they preclude appropriate responses or interfere with other functions by diverting attention away from other critical signals. [Source: MIL-STD-1472F, 5.3.4.2.1]

- **8.16.1.1.14 Feedback about alarms and alerts.** Users shall be provided informative feedback for actions that trigger alarm and alerting signals. [Source: MIL-STD-1801, 4.2.5.2]

- **8.16.1.1.15 Alarm help.** When necessary, users shall be able to request help and related information for the operation and processing of critical and non-critical alarms, messages, and signals. [Source: MIL-STD-1801, 4.2.5.2]

8.16.1.2 Acknowledging signals

- **8.16.1.2.1 Special acknowledgement of critical alarms.** When a user must acknowledge a special or critical alarm in a unique way (e.g., with a special combination of key strokes), this special acknowledgement shall not inhibit or slow the response to the condition initiating the alarm. [Source: DOE HFDG ATCCS, V2.0, 2.6.1; MIL-HDBK-761A, 5.1.1.11.d]

- **8.16.1.2.2 Alarm reset.** A system or application shall provide users with a simple means for turning off non-critical auditory alarms without erasing any displayed message that accompanies the auditory signal. [Source: DOE HFDG ATCCS, V2.0, 2.6.2; MIL-HDBK-761A, 5.1.1.11.c; MIL-STD-1801, 4.2.5.35]

- **8.16.1.2.3 Acknowledging and terminating alarms.** A system or application shall provide users with a means of acknowledging alarms and of turning off alarm signals once the alarms have been acknowledged or the condition generating the alarm has been corrected. [Source: MIL-STD-1801, 4.2.5.2]

- **8.16.1.2.4 Procedures for acknowledging alarms.** Procedures for acknowledgment and termination shall not decrease the speed and accuracy of operator reaction to the alerting situation. [Source: MIL-STD-1801, 4.2.5.2]

- **8.16.1.2.5 Consistent means of acknowledging.** A simple, consistent means of acknowledging auditory signals shall be provided. [Source: MIL-HDBK-761A, 5.3.1.6.2.b]

- **8.16.1.2.6 Acknowledging signals.** When the signal is non-critical, the acknowledgement action shall also turn the signal off. [Source: MIL-HDBK-761A, 5.3.1.6.2.b]

- **8.16.1.2.7 Auditory feedback.** The most common auditory feedback, the system beep, should be used with other forms of notification such as flashing or message dialogs. [Source: Microsoft Corp., 1992 - 3.6.2]

8.16.1.3 Number of signals

- **8.16.1.3.1 Number of audio signals for absolute identification.** When absolute identification is required, the number of signals to be identified should not exceed four. [Source: MIL-STD-1472F, 5.3.4.3.1]

  Discussion. Research shows that between 4 to 7 alarms can be acquired reasonably quickly, performance decreases dramatically for additional alarms. The meanings associated with up to nine alarms can be retained if the alarms are presented regularly. [Source: Patterson, 1982; Stanton & Edworthy, 1994]

- **8.16.1.3.2 Number of audio signals for relative identification.** When relative discrimination is required, the number of alarm signals should not exceed 12. [Source: Stanton & Edworthy, 1994]

- **8.16.1.3.3 Single audio signal.** A single audio signal should be used in conjunction with multiple visual displays only if immediate identification of the appropriate visual display is not critical to personnel safety or system performance. [Source: MIL-STD-1472F, 5.3.1.5]

8.16.1.4 Differentiating signals

- **8.16.1.4.1 Differentiating signals.** Auditory signals that require different user responses should be easily distinguishable from one another. [Source: MIL-STD-1472F, 5.3.4.3.2]

  Example. Varying frequency, modulation, or both can differentiate signals. One purpose of differentiating the signals is to minimize the user's search of visual displays. [Source: MIL-STD-1472F, 5.3.4.3.2]

- **8.16.1.4.2 Differentiation from routine signals.** Audio alarms intended to attract the user's attention to a malfunction or failure shall be different from routine signals such as bells, buzzers, random noises generated by air conditioning and other equipment, and normal operation noises. [Source: MIL-STD-1472F, 5.3.4.3.5]

- **8.16.1.4.3 Multiple audio signals.** When several different audio signals will be used to alert a user to different conditions, the signals shall be distinctive in intensity, pitch, or use of beats and harmonics. [Source: MIL-STD-1472F, 5.3.4.3.1]

- **8.16.1.4.4 Unsuitable auditory signals.** Auditory signals should not be used if they resemble sounds that can occur in the actual operational setting. [Source: National Air Traffic Services, 1999 - 1.11.18.1.6]

  Example. Sounds that are similar to navigational signals or radio transmissions and hisses or humming sounds similar to electrical interference would not be good candidates for audio signals.

- **8.16.1.4.5 Noninterference.** Audio warning signals shall not interfere with any other critical functions or warning signals or mask any other critical audio signals. [Source: MIL-STD-1472F, 5.3.4.5.1]

8.16.1.5 Established signals

- **8.16.1.5.1 Consistent signals.** The meaning of audio warning signals selected for a particular function in a system should be consistent with warning signal meanings already established for that function. [Source: MIL-STD-1472F, 5.3.4.4.1]

- **8.16.1.5.2 New meanings for standard signals.** Standard signals shall not be used to convey new meanings. [Source: MIL-STD-1472F, 5.3.4.4.2]

- **8.16.1.5.3 Established signals.** Established signals should be used provided they are compatible with the acoustic environment and voice communication systems. [Source: MIL-STD-1472F, 5.3.4.4.2]

8.16.1.6 Prioritizing alarms

- **8.16.1.6.1 Message priorities.** A message priority system shall be established so that a more critical message shall override the presentation of any message having a lower priority. [Source: MIL-STD-1472F, 5.3.5.6.2]

  Definition.
  Caution - A signal that indicates the existence of a condition requiring attention but not immediate action. [Source: Department of Defense, 1991 – 3.5.1]

  Warning - A signal that indicates the existence of a hazardous condition requiring immediate action to prevent loss of life, equipment damage, or a service interruption. [Source: Department of Defense, 1991 – 3.5.2]

  Advisory - A signal that indicates a safe or normal configuration, condition of performance, or operation of essential equipment, or attracts attention and imparts information for routine action purposes. [Source: Department of Defense, 1991 – 3.13.1]

- **8.16.1.6.2 Warning signals.** Warning signals shall be used to indicate the existence of a hazardous condition requiring immediate action to prevent loss of life, equipment damage, or a service interruption. [Source: Department of Defense, 1991 – 3.5.2]

- **8.16.1.6.3 Caution signals.** Caution signals shall be used to indicate conditions requiring awareness but not necessarily immediate action. [Source: MIL-STD-1472F, 5.3.2.3]

- **8.16.1.6.4 Distinguishing caution signals.** Caution signals shall be readily distinguishable from warning signals. [Source: MIL-STD-1472F, 5.3.2.3]

- **8.16.1.6.5 Distinctive and consistent alarms.** Alarm signals and messages shall be distinctive and consistent for each class of event. [Source: DOE HFDG ATCCS, V2.0, 2.6.3; MIL-HDBK-761A, 5.1.1.11.b; MIL-STD-1801, 4.2.5.1]

  Example. A signal alerting a user to an incoming message would be different from a signal alerting a user to a hazardous condition. [Source: DOE HFDG ATCCS, V2.0, 2.6.3; MIL-HDBK-761A, 5.1.1.11.b; MIL-STD-1801, 4.2.5.1]

- **8.16.1.6.6 Simultaneous alarms.** When two or more incidents or malfunctions occur simultaneously, the one generating a message of higher priority shall be presented first. After presentation of the highest priority message, remaining messages shall be presented in descending order of priority. [Source: MIL-STD-1472F, 5.3.5.6.2]

- **8.16.1.6.7 System failure.** In the event of a complete system failure, the system shall integrate messages and report the system failure rather than the failure of components. [Source: MIL-STD-1472F, 5.3.5.6.2]

8.16.1.7 Periodicity

- **8.16.1.7.1 Intermittence.** Auditory signals should be intermittent rather than continuous. [Source: MIL-HDBK-761A, 5.3.1.6.2.d]

  Discussion. Continuous tones are the most easily confused signals, even if they vary considerably in pitch. Furthermore, the human auditory system quickly adapts to continuous auditory stimulation. [Source Merideth & Edworthy, 1994]

- **8.16.1.7.2 Nature of signals.** Audio warning signals should consist of two elements, an alerting signal and an identifying or action signal. [Source: MIL-STD-1472F, 5.3.2.2]

8.16.1.8 Duration

- **8.16.1.8.1 Two-element signals.** When reaction time is critical and a two-element signal is used, an alerting signal of 0.5 seconds duration shall be provided followed by an identifying or action signal with all essential information being transmitted in the first 2 seconds of the identifying or action signal. [Source: MIL-STD-1472F, 5.3.2.2.1]

- **8.16.1.8.2 Reaction time critical.** When reaction time is critical, signals shall be of short duration. [Source: MIL-STD-1472F, 5.3.2.2.2]

- **8.16.1.8.3 Single-element signal.** When a single-element signal is used, all essential information shall be transmitted in the first 0.5 seconds [Source: MIL-STD-1472F, 5.3.2.2.2]

- **8.16.1.8.4 Duration.** Audio warning signal duration shall be at least 0.5 seconds and may continue until the appropriate response is made. [Source: MIL-STD-1472F, 5.3.6.5]

- **8.16.1.8.5 Duration limitations.** Signals that persist or increase progressively in loudness shall not be used if manual shutoff may interfere with the corrective action required. [Source: MIL-STD-1472F, 5.3.6.6]

- **8.16.1.8.6 Signal termination.** Completion of a corrective action by the user or by other means shall automatically terminate the signal. [Source: MIL-STD-1472F, 5.3.6.5]

8.16.1.9 Frequency

- **8.16.1.9.1 Frequency range.** The frequency range of a warning signal shall be between 200 and 5,000 Hz, preferably between 500 and 3,000 Hz. [Source: MIL-STD-1472F, 5.3.3.1.1]

- **8.16.1.9.2 Frequency for long distances.** When a signal must be audible at a distance of 300 m (985 ft) or more, the frequency shall be below 1,000 Hz. [Source: MIL-STD-1472F, 5.3.3.1.1]

- **8.16.1.9.3 Signals around obstacles.** When the signal must be heard around obstacles or through partitions, the frequency shall be below 500 Hz. [Source: MIL-STD-1472F, 5.3.3.1.1]

- **8.16.1.9.4 Frequencies differing from background.** The selected frequency band shall differ from the most intense background frequencies. [Source: MIL-STD-1472F, 5.3.3.1.1]

- **8.16.1.9.5 Spurious signals.** The frequency of a warning tone shall be different from that of the electric power employed in the system to preclude the possibility that a minor equipment failure might generate a spurious signal. [Source: MIL-STD-1472F, 5.3.3.1.2]

- **8.16.1.9.6 Frequencies difficult to localize.** Mid-frequencies (1500-3000 Hz) should not be used for auditory alarms that require localization. [Source: Sanders & McCormick, 1987].

8.16.1.10 Intensity (loudness)

- **8.16.1.10.1 Environmental compatibility.** The intensity, duration, and source location of an auditory signal should be compatible with the acoustic environment of the intended receiver as well as with the requirements of other personnel within acoustic range of the signal. [Source: MIL-HDBK-761A, 5.3.1.6.2.f]

  Discussion. Avoid the use of loud sounds unless the task requires it (e.g., the environment is loud and it is critical that the user hear the sounds).

- **8.16.1.10.2 Compatibility with clothing and equipment.** When the audio alarms and signals must be heard and understood through equipment or garments (e.g., parka hoods and hearing protective devices covering the ears of a listener), audio signals shall be loud enough to compensate for the attenuation characteristics of the garments without exceeding 115 dB(A) for emergency signals and 90 dB(A) for other signals. [Source: MIL-STD-1472F, 5.3.3.2.2 & 5.3.3.2.3]

- **8.16.1.10.3 Exceeding ambient noise.** Auditory signals shall exceed the prevailing ambient noise level by at least 10 dB(A) or any maximum sound level with a duration of 30 seconds by at least 5 dB(A), whichever is louder, without exceeding 115 dB(A)for emergency signals or 90 dB(A) for other signals. [Source: MIL-STD-1472F, 5.3.4.1; NUREG-0700, 6.2.2.6]

- **8.16.1.10.4 Maximum intensity.** The intensity of evacuation and emergency signals shall not exceed 115 dB(A). The intensity of other signals shall not exceed 90 dB(A). [Source: MIL-STD-1472F, 5.3.4.1;NUREG-0700, 6.2.2.6]

- **8.16.1.10.5 Control of volume.** The user, the sensing mechanism, or both shall control the volume (loudness) of an audio warning signal depending upon the operational situation and personnel safety. [Source: MIL-STD-1472F, 5.3.6.4.1]

- **8.16.1.10.6 Volume limits.** Volume control movement shall be restricted to prevent reducing the volume to an inaudible level or increasing it to an unacceptably high level. [Source: MIL-STD-1472F, 5.3.6.4.1]

8.16.1.11 Presentation over headsets

- **8.16.1.11.1 Headset.** When the user will wear earphones covering both ears during normal equipment operation, the audio warning signal shall be directed to the user's headset as well as to the work area. [Source: MIL-STD-1472F, 5.3.4.2.4]

- **8.16.1.11.2 When not to use headsets.** Binaural headsets should not be used in any operational environment with ambient noise below 85 dB(A) if that environment contains sounds that provide the user with useful information and that information cannot be directed to the user's headset. [Source: MIL-STD-1472F, 5.3.4.2.4]

  Discussion. Such sounds may include voices, machine noise that indicates wear or malfunctions, and other auditory indications of system performance or mission status. [Source: MIL-STD-1472F, 5.3.4.2.4]

- **8.16.1.11.3 Separate channels.** When feasible, a warning signal delivered to a headset that might mask another essential audio signal should be delivered to one ear and the other signal to the other ear. [Source: MIL-STD-1472F, 5.3.4.2.3]

- **8.16.1.11.4 Dichotic presentation.** When earphones will be worn in an operational environment, a dichotic presentation should be used whenever feasible, with the signal alternating from one ear to the other by means of a dual-channel headset**.** [Source: MIL-STD-1472F, 5.3.4.2.3]

8.16.2 Auditory coding

- **8.16.2.1 Appropriate use.** Auditory coding should be used

  a. to alert users to critical conditions or operations;

  b. to supplement visual signals;

  c. to present information in situations in which visual presentation is not feasible; and

  d. to provide feedback for control actuation, data entry, or the completion of timing cycles and sequences. [Source: MIL-HDBK-761A, 5.3.1.6.2.a]

- **8.16.2.2 Inappropriate use.** Auditory coding should not be used when ambient noise prevents effective listening. [Source: National Air Traffic Services, 1999 - 1.11.18.1.5]

8.16.3 Verbal warning signals

8.16.3.1 General

- **8.16.3.1.1 When to use.** Verbal warning signals should be used

  a. to supplement visual displays when communication flexibility is necessary,

  b. when coded signal meanings are numerous or may be forgotten,

  c. for presentation of complex directions or instructions,

  d. when ambient noise may mask simple tonal signals,

  e. in conjunction with tonal signals, and

  f. for presentation of continuous information when the rate of change is low. [Source: MIL-HDBK-761A, 5.3.3]

- **8.16.3.1.2 Nature of signals.** Verbal warning signals shall consist of a brief, standardized speech signal (e.g., a verbal message) to identify the specific condition and suggest an appropriate action. [Source: MIL-STD-1472F, 5.3.5.1]

- **8.16.3.1.3 Acknowledging warning signals.** The system should require that users acknowledge spoken warning signals. [Source: MIL-HDBK-761A, 5.3.3.2.c]

8.16.3.2 Intensity

- **8.16.3.2.1 Intensity.** Verbal signals for critical functions shall be at least 20 dB above the speech interference level at the operating position of the intended receiver but shall not exceed 90 dB(A). [Source: NUREG-0700, 6.2.2.6; MIL-STD-1472F, 5.3.5.2]

  Definition. Speech interference level is a measure of the effectiveness of noise in masking speech. It is the arithmetic mean of the same pressure levels of interfering noise (in dB re 20☞ Pa) in the four octave bands centered on the frequencies 500, 1000, 2000, and 4000 Hz, respectively. The unit of speech interference is the decibel (dB). [Source: NUREG-0700, 6.2.2.6; MIL-STD-1472F, 5.3.5.2]

- **8.16.3.2.2 Speech intensity.** Speech intensity should be appropriate to the expected ambient noise environment, with a signal to noise ratio of at least 5:1. [Source: MIL-HDBK-761A, 5.3.3.2.b]

8.16.3.3 Word selection

- **8.16.3.3.1 Word choice.** The words used in verbal signals shall be concise, intelligible, and appropriate to the task and the information presented. [Source: MIL-HDBK-761A, 5.3.3.1.a]

- **8.16.3.3.2 Words to avoid.** To the extent possible, words that rhyme with other words or that sound similar in other ways should be avoided if these other words might be used in the same context and, therefore, possibly be confused with the original words. [Source: MIL-HDBK-761A, 5.3.3.1.b]

- **8.16.3.3.3 Formal words.** Formal or correct words should be used; slang, jargon, and colloquial words should be avoided. [Source: MIL-HDBK-761A, 5.3.3.1.c]

- **8.16.3.3.4 Alphabetic information.** Alphabetic information should be presented using a phonetic alphabet that uses words like alpha, bravo, and Charlie rather than the letters A, B, and C. [Source: MIL-HDBK-761A, 5.3.3.1.e]

8.16.3.4 Presentation

- **8.16.3.4.1 Average talker.** Spoken messages should sound like an average talker from the user country without a regional dialect. [Source: MIL-HDBK-761A, 5.3.3.2.a]

- **8.16.3.4.2 Distinctive voices.** When different categories of voice signals are used, a different, distinctive voice should be used for each category of data. [Source: MIL-HDBK-761A, 5.3.1.6.2.g]

  > **Example.** One voice might be used for instructional messages and another for warnings. [Source: MIL-HDBK-761A, 5.3.1.6.2.g]

- **8.16.3.4.3 Content.** Spoken messages should be brief, informative, and to the point. [Source: MIL-HDBK-761A, 5.3.3.2.d]

- **8.16.3.4.4 Type of voice.** The voice used in recording verbal warning signals should be mature and distinct enough not to be confused with voice communications including radio and intercom communications. [Source: MIL-STD-1472F, 5.3.5.3.1]

- **8.16.3.4.5 Delivery style.** Verbal warning signals shall be presented in a formal, impersonal manner. [Source: MIL-STD-1472F, 5.3.5.3.2]

- **8.16.3.4.6 Repetition.** Critical warning signals shall be repeated with not more than a 3 sec pause between messages until the condition is corrected or overridden by an operator or user. [Source: MIL-STD-1472F, 5.3.5.6.1]

- **8.16.3.4.7 Speech processing.** Verbal warning signals shall be processed only if necessary to increase or preserve intelligibility, for example, by increasing the strength of consonant sounds relative to vowel strength. [Source: MIL-STD-1472F, 5.3.5.4]

  Discussion. When a signal must be relatively intense because of high ambient noise, peak clipping may be used to protect the listener against auditory overload. [Source: MIL-STD-1472F, 5.3.5.4]

8.17 System Operations

8.17.1 General

- **8.17.1.1 System support functions.** Each system should provide a screen saver, the ability to suspend a session without completely logging off (the system would continue all active processes but not allow interaction until a user logs on again), and easy identification of and navigation among all open windows. [Source: DON UISNCCS, V1.2, 7.4.1]

- **8.17.1.2 Resetting parameters.** At the end of a session, any parameters with settings that apply only to the current session should be reset to their default values. [Source: DON UISNCCS, V1.2, 7.4.2]

- **8.17.1.3 System interrupts.** A system or application shall interrupt a user only when necessary to prompt the user for a response, to provide essential feedback, or to inform the user of errors. [Source: DOE HFDG ATCCS, V2.0, 2.4.9]

- **8.17.1.4 Indication of activation.** No system function shall be activated without an indication to the user. [Source: DOE HFDG ATCCS, V2.0, 4.1.2; MIL-HDBK-761A, 5.1.7.3.a, 5.1.7.3.b; MIL-STD-1801, 4.1.1.4.c]

- **8.17.1.5 Entry acknowledgement.** Every user action shall result in a response from the system. [Source: DOE HFDG ATCCS, V2.0, 2.0, 2.1.15.2; MIL-HDBK-761A, 5.1.1.10.a]

- **8.17.1.6 User-specified settings.** Users should be able to review user specified interface parameters and reset them at any time during a session. [Source: DON UISNCCS, V1.2, 7.4.2]

  Discussion. Design the system with a default for each setting, and decide which interface parameters users will be given access to and allowed to set. Decide which of these settings will remain in effect for the current session only and which will be in effect whenever that user logs on. [Source: DON UISNCCS, V1.2, 7.4.2]

8.17.2 Screen saver

- **8.17.2.1 Screen saver.** Computer system software should, when necessary to preserve the monitor, provide a screen saver that blanks computer screens or displays a message or graphic display that changes periodically when the computer has been idle for a period of time. [Source: DOD HCISG V2.0, 4.1.1]

  Exception. A screen-saver mode is not appropriate for displays containing screens such as a constant monitor screen or a display in which users must track an activity over a period of time.

- **8.17.2.2 Screen-saver activation.** The time activation of the screen saver should be user selectable with a suggested activation time of 5 minutes. [Source: DOD HCISG V2.0, 4.1.1]

- **8.17.2.3 Screen-saver deactivation.** The screen saver should be deactivated when any new activity is detected, including pressing any key on the keyboard or moving a pointing device. [Source: DOD HCISG V2.0, 4.1.1]

8.17.3 System access, log on and log off

- **8.17.3.1 System access through log-on process.** When necessary, each system shall implement a log-on procedure that users must complete before they can access any system functions. [Source: DON UISNCCS, V1.2, 7.1.1]

  Discussion. Systems may restrict the applications available to a user based on the user's log-on identification. Alternatively, systems may require users to log on to individual applications or groups of applications. [Source: DON UISNCCS, V1.2, 7.1.1]

- **8.17.3.2 Multiple user access.** Where multiple users have simultaneous access to computer control or output, the operation by one person shall not interfere with the operations of another unless mission survival necessitates pre-emption. [Source: MIL-HDBK-761A, 5.1.1.c]

- **8.17.3.3 User access pre-emption.** Where applicable, provisions for pre-emption and pre-notification shall be provided. [Source: Department of Defense, 1996 - 5.15.1.8]

- **8.17.3.4 Resuming pre-empted operations.** Provisions shall be made for the pre-empted user to be able to resume operations without information loss. [Source: Department of Defense, 1996 - 5.15.1.8]

- ▫ **8.17.3.5 Log-on screen.** When a system uses a log-on procedure, a log-on screen should be displayed automatically as soon as a user completes any required start-up or power-up procedures. [Source: DOD HCISG V2.0, 4.1.1]

- ▫ **8.17.3.6 Log-on status.** When the system is unavailable for log on, it should display a message stating the system status and when it will be available. [Source: DON UISNCCS, V1.2, 7.1.1]

- ▪ **8.17.3.7 Log-on prompts.** When a system log-on procedure includes both an identification component (e.g., a user's name) and an authentication component (e.g., a user's password), the system shall provide a self-explanatory prompt for each component with each prompt on a separate line. [Source: DOD HCISG V2.0, 4.1.1]

- ▪ **8.17.3.8 User name and password.** When a log-on procedure includes the entry of a user's name and a password, the system shall show the user's name but shall not display the password on the screen. [Source: DOD HCISG V2.0, 4.1.1, 9.1.3]

- ▪ **8.17.3.9 Error messages.** When a user makes an error during the log-on procedure, the system shall display an error message in the system message area or in a standard pop-up error window that provides guidance on how to correct the error but not information that could assist someone trying to break into the system. [Source: DOD HCISG V2.0, 4.1.1]

- ▫ **8.17.3.10 Completion of log on.** Upon completion of a log on, the system should display a main menu or an application window. [Source: DOD HCISG V2.0, 4.1.5]

- ▪ **8.17.3.11 System log off.** Once a user is logged on a system, the user shall be able to log off a system at any time by selecting the **Log off** option from a system-level menu. [Source: DOD HCISG V2.0, 4.1.4 and DOD HCISG V2.0, 4.1.4]

- ▫ **8.17.3.12 Applications running during log off.** The system should notify the user of any applications that are still running before confirming a system log off. [Source: DON UISNCCS, V1.2, 7.5.1]

- ▪ **8.17.3.13 Confirming a log off.** The system shall prompt the user to confirm a log-off request. [Source: DOD HCISG V2.0, 4.1.4]

- ▪ **8.17.3.14 Completion of log off.** After completing a system log off, the system shall display the initial system log-on screen. [Source: DOD HCISG V2.0, 4.1.4; DON UISNCCS, V1.2, 7.5.1]

- ▫ **8.17.3.15 Automatic log-off time.** When a system includes an automatic log off due to user inactivity, a standard elapsed time modifiable by the user should be designated. [Source: DON UISNCCS, V1.2, 7.5.2]

- **8.17.3.16 Automatic log-off warning.** During periods of inactivity, the system should display a message accompanied by an auditory warning signal stating the action necessary to avoid automatic log off (e.g., a keystroke or movement of the pointing device). [Source: DON UISNCCS, V1.2, 7.5.2]

- **8.17.3.17 Auto-saving data after automatic log off.** When automatic log off occurs, the system should auto-save any unsaved data, display a message indicating that automatic log off has occurred, and provide the name of the file in which data have been saved. [Source: DON UISNCCS, V1.2, 7.5.2]

8.17.4 Application - log on and log off

An application available in a system may require its own log-on and log-off procedures separate from the system log on.

- **8.17.4.1 Log on.** When an application log on is required in addition to the system log on, it shall conform to the same rules as system log on. [Source: DON UISNCCS, V1.2, 7.5.2]

- **8.17.4.2 Log off.** Logging off an application shall be accomplished with an exit function that is available to users at all times while they are logged on to the application. [Source: DOD HCISG V2.0, 4.1.3]

- **8.17.4.3 Confirming an exit.** The system shall prompt the user to confirm an application-exit request. [Source: DOD HCISG V2.0, 4.1.3]

- **8.17.4.4 Preserving unfinished work.** When the application contains unsaved inputs when the log off request is made, the application shall prompt the user to save the work, confirm the log off, or cancel the request. [Source: DOD HCISG V2.0, 4.1.3 and DOD HCISG V2.0, 4.1.4]

- **8.17.4.5 Logging off an application.** Logging off an application shall result in the removal of all screens associated with that application. [Source: DOD HCISG V2.0, 4.1.3]

- **8.17.4.6 Single application.** When there is only one application running, logging off of that application shall result in the system main menu being displayed. [Source: DOD HCISG V2.0, 4.1.3]

- **8.17.4.7 Multiple applications.** When there are multiple applications running, logging off an application shall result in the next most current application being displayed. [Source: DOD HCISG V2.0, 4.1.3]

8.17.5 Data back up

- **8.17.5.1 Paper copy.** Users should be able to obtain a paper copy of the exact contents of an alphanumeric or graphic display in systems in which mass storage is limited, mass stored data can be lost by power interruption, or record keeping is required. [Source: MIL-HDBK-761A, 5.3.1.1.e]

- **8.17.5.2 Computer failure.** When partial computer hardware or software failure occurs, the program should allow for orderly shutdown and establish a checkpoint so restoration can be accomplished without loss of computing performed to date. [Source: Department of Defense, 1996 - 5.15.1.7]

  Discussion. Critical FAA facilities and services often have redundant computer systems that switch to backup or degraded operations modes during failures. This guideline is a reminder to conserve appropriate data and facilitate restoration where prior work needs to be preserved.

8.17.6 System response time

In designing any application, response time is critical. The response of an application is dependent on hardware and other processes requiring central processor unit (CPU) use (e.g., a multitasking system may be slowed by other concurrent applications) and therefore, is hard to quantify. Thus, the rules in this section need to take into account such factors.

8.17.6.1 General

- **8.17.6.1.1 Appropriate system response time.** The response time of a system to a user action shall be appropriate to the type of transaction, the time constraints of the task, and any specific data processing requirements. [Source: DOE HFDG ATCCS, V2.0, 2.1.17.1, 2.1.17.2; MIL-HDBK- 761A, 5.1.1.12.a]

- **8.17.6.1.2 Maximum system response times.** System response times shall not exceed the values given in Exhibit 8.17.6.1.2 for the system tasks listed. [Source: DOE HFDG ATCCS, V2.0, 2.1.14.4; MIL-HDBK-761A, 5.1.1.12.b]

Exhibit 8.17.6.1.2 Maximum system response times for routine system tasks

System interpretation	Response time definition	Maximum response time (sec)
Key response	From key depression until positive response, for example, "click" or display echo	0.1
Key print (echo)	From key depression until appearance of character	0.2
Page turn	From end of request until first few lines are visible	1.0
Page scan	From end of request until text begins to scroll	0.5
Data field entry	From selection of field until visual verification	0.2
Function selection	From selection of command until response	2.0
Pointing	From input of point to display of point or pointing device	0.2
Drawing, sketching	From input of point to display of point, line, arc, etc.	0.2
Local update	Change to image or display using local data base, for example, new menu list display	0.5
Host update	Change where data are at host in a readily accessible form, for example, a display scale change	2.0
File update	Image or display update requiring access to a host file	10.0
Simple inquiry	From command until display of a common message	2.0
Complex inquiry	Response message that requires seldom used calculations in graphic form	10.0
Error feedback	From entry of input until error message appears	2.0

- **8.17.6.1.3 System response-time variability.** The variability of system response times for processing various types of control actions shall be minimized. [Source: MIL-HDBK-761A, 5.1.1.12.f]

- **8.17.6.1.4 Maximum system-response time variability.** System-response time variability shall not exceed 5% when processing in the range of 0 to 2 sec; 10% when processing in the range 2 to 5 sec; and 15% when processing longer than 5 sec. [Source: MIL-HDBK-761A, 5.1.1.12.f]

- **8.17.6.1.5 Acknowledgement of delayed processing.** When the processing of a control entry must be delayed, the current control entry shall be acknowledged. [Source: MIL-HDBK-761A, 5.1.1.12.d]

- **8.17.6.1.6 Notification of processing completion.** When the processing is time consuming or not otherwise obvious, the system shall notify the user when the processing is complete. [Source: MIL-HDBK-761A, 5.1.1.12.e]

8.17.6.2 Keyboard lockout

- **8.17.6.2.1 Response-time-induced keyboard lockout.** When application processing prohibits acceptance of keyboard input and no keyboard buffer is available, the application should lock out the keyboard until the application can accept input. [Source: DOE HFDG ATCCS, V2.0, 2.1.16.1]

  Definition. Keyboard lockout is a state determined by an application in which the application does not accept input from the keyboard. [Source: DOE HFDG ATCCS, V2.0, 2.1.16.1]

- **8.17.6.2.2 Notification of keyboard lockout.** When keyboard lockout occurs, as alert should be displayed to indicate the user that lockout has occurred. [Source: DOE HFDG ATCCS, V2.0, 2.1.16.1; Nuclear Regulatory Commission, 1996 - 2.4.7-6]

- **8.17.6.2.3 Lockout duration.** Temporary lockout of a keyboard or other device due to processing of a transaction control entry shall be minimized. [Source: MIL-HDBK-761A, 5.1.1.12.c]

- **8.17.6.2.4 Lockout indication.** When an application incorporates keyboard lockout, it shall provide a clear indication to users when the keyboard is locked out and when it is not. [Source: DOE HFDG ATCCS, V2.0, 2.1.16.2]

  Example. One way this might be done is to change the shape of the cursor or pointer to a watch or hourglass. [Source: DOE HFDG ATCCS, V2.0, 2.1.16.2]

- **8.17.6.2.5 Lockout override.** An application that incorporates keyboard lockout should also provide a means for overriding the lockout, such as by assigning a function key to have this effect. [Source: DOE HFDG ATCCS, V2.0, 2.1.16.3]

- **8.17.6.2.6 Preserving processing prior to lockout override.** When lockout override is provided and it is invoked, the system should not reset and lose any processing that was completed before the override was invoked. [Source: DOE HFDG ATCCS, V2.0, 2.1.16.3]

8.17.7 Prompting

- **8.17.7.1 Prompting.** A system or application shall prompt users for all required input parameters, request additional or corrected information as needed, provide orientation (as to the computer processes to users) during transactions, and indicate any errors that are detected. [Source: MIL-HDBK-761A, 5.1.1.8.a]

- **8.17.7.2 Prompt contents.** When the computer is waiting for input from a user, it shall indicate clearly where on the screen the input is expected and, to the extent possible, what information is expected. [Source: MIL-HDBK-761A, 5.1.1.8.b, 5.1.4.e]

- **8.17.7.3 Location of prompts.** Prompting messages shall appear in a consistent location on the screen. [Source: MIL-HDBK-761A, 5.1.1.8.e]

  Example. Prompting could occur at the beginning of the next line to be typed, in the data field where an entry is to be made, at a command input line, or within a menu window from which a selection is to be made. [Source: MIL-HDBK-761A, 5.1.1.8.e]

- **8.17.7.4 Duration of prompts.** When a computer requests information from a user, any instructions about how to supply the information should remain visible until the user complies or takes some other action. [Source: DOE HFDG ATCCS, V2.0, 2.1.12]

- **8.17.7.5 User-selected level of prompting detail.** A system or application should permit users to select the level of detail they want in prompts. [Source: MIL-HDBK-761A, 5.1.1.8.d]

  Exception. Do not provide this capability if the system or application is shared in a way that would allow one user selection to affect another user. [Source: MIL-HDBK-761A, 5.1.1.8.d]

- **8.17.7.6 User requested prompts.** The system should allow a user to request the display of prompts for the entry of data and command parameters. [Source: MIL-STD-1801, 4.6.5.3]

8.17.8 Feedback

- **8.17.8.1 System not available.** When the system is not immediately available after system startup, the system should provide feedback to the user indicating average system response time or known periods of unavailability and disable the keyboard and pointing device until startup is complete.

  Example. This feedback could take many forms such as displaying a message stating its unavailability, showing a status bar, or changing the pointer shape to a watch or hourglass.

- **8.17.8.2 System available.** When startup is complete and the system becomes available the system should remove any messages indicating that it is unavailable, return the pointer to its normal shape, and enable the keyboard and pointing device. [Source: DON UISNCCS, V1.2, 7.1.3]

- **8.17.8.3 Feedback.** Designers shall present feedback by way of status, confirmation, and verification information throughout the interaction. [Source: Department of Defense, 1996 - 5.15.5.1]

- **8.17.8.4 Periodic feedback messages.** Successive periodic feedback messages should differ in wording from presentation to presentation or be otherwise indicated. [Source: MIL-HDBK-761A, 5.1.1.10.d]

  Example. Three successive messages might be (1) "Processing search -- please wait." (2) "Search continuing -- please wait." (3) "Processing search -- wait please." [Source: MIL-HDBK-761A, 5.1.1.10.d]

- **8.17.8.5 "Working" indication.** When a system or application takes more than 2 seconds to complete an operation initiated by a user action and during this time it is incapable of accepting further input from the user, it shall inform the user that action is continuing. [Source: DOE HFDG ATCCS, V2.0, 2.4.6]

  Discussion. A dynamic aspect to the working message is highly desirable. For example, the message might display the percent of processing that has been completed or that remains, with the percentage updated regularly. When this is not possible, a display that changes with time is still desirable (e.g., a row of dots with a new dot added periodically). [Source: DOE HFDG ATCCS, V2.0, 2.4.6]

- **8.17.8.6 Standby.** When the user must stand by due to system functioning, a "working," "busy," or "wait" message or appropriate icon should be displayed until user interaction is again possible. [Source: Department of Defense, 1996 - 5.15.5.2]

- **8.17.8.7 Periodic feedback.** When the system takes more than 2 seconds to respond, it shall provide periodic feedback to the user indicating that normal operation is occurring. [Source: DOE HFDG ATCCS, V2.0, 2.0, 2.1.15.1; MIL-HDBK-761A, 5.1.1.10.c]

- **8.17.8.8 Delays greater than 15 seconds.** The user should be informed if the delay is likely to exceed 15 seconds. [Source: MIL-HDBK-761A, 5.3.1.6.2.c]

- **8.17.8.9 Delays exceeding 60 seconds.** For delays exceeding 60 seconds, a countdown display should show delay time remaining. [Source: Department of Defense, 1996 - 5.15.5.2]

- **8.17.8.10 Delayed computer response.** When the computer response to a user request is greater than 15 seconds, the computer shall give a clear and positive indication (e.g., an auditory signal) when processing is complete. [Source: MIL-HDBK-761A, 5.3.1.6.2.c]

- **8.17.8.11 Feedback message content.** Feedback messages shall be self-explanatory. (Users shall not be required to translate feedback messages by use of reference system or code sheets.) [Source: Department of Defense, 1996 - 5.15.5.8]

- **8.17.8.12 Abbreviations in feedback.** Abbreviations should be avoided in feedback messages. [Source: Department of Defense, 1996 - 5.15.5.8]

- **8.17.8.14 Feedback for delayed response to function key activation.** When the function key activation does not result in an immediately observable response from the computer, the user shall be given some other form of acknowledgment or feedback. [Source: DOE HFDG ATCCS, V2.0, 4.1.2; MIL-HDBK-761A, 5.1.7.3.a, 5.1.7.3.b; MIL-STD-1801, 4.1.1.4.c]

- **8.17.8.15 Time consuming process.** The system shall give the user warning information before a command is invoked that it will be time consuming to process. [Source: Department of Defense, 1996 - 5.15.5.9]

- **8.17.8.16 Process outcome.** When a control process or sequence is completed or aborted by the system, positive indication shall be presented to the user concerning the outcome of the process and the requirements for subsequent user action. [Source: Department of Defense, 1996 - 5.15.5.3]

- **8.17.8.17 Current mode indication.** When multiple modes of operation exist, a means should be provided to remind the user of the current mode. [Source: Department of Defense, 1996 - 5.15.5.5]

- **8.17.8.18 Highlighted option acknowledgement.** Any displayed message or datum selected as an option or input to the system shall be highlighted to indicate acknowledgement by the system. [Source: Department of Defense, 1996 - 5.15.5.6]

- **8.17.8.19 Rejected input feedback.** When the system rejects user input, self-explanatory feedback shall be provided to indicate the reason for rejection and the required corrective action. [Source: Department of Defense, 1996 - 5.15.5.7]

8.17.9 Status information

- **8.17.9.1 Availability of status information.** Information about the current status of the system should be available to users at all times and, as appropriate to the system, provided automatically or upon user request. [Source: MIL-HDBK-761A, 5.4.2.2.1.a, 5.4.2.2.1.d; MIL-STD-1801, 4.6.2.1, 4.6.2.2, 4.6.2.3]

  Discussion. System status information might include information about data processing status, system availability, operational mode, system load, other users, and external systems. [Source: MIL-HDBK-761A, 5.4.2.2.1.a, 5.4.2.2.1.d; MIL-STD-1801, 4.6.2.1, 4.6.2.2, 4.6.2.3]

- **8.17.9.2 Status of alarm settings.** Users should be able to obtain status information concerning current alarm settings (e.g., the dimensions or variables covered and the values or categories established as critical). [Source: MIL-HDBK-761A, 5.4.2.2.1.b]

- **8.17.9.3 Status of other systems or users.** When interaction with other systems or users is required, status information about the other systems or users should be available. [Source: MIL-HDBK-761A, 5.4.2.2.1.c]

8.17.10 Routine messages

- **8.17.10.1 Routine feedback.** The system shall provide users with consistent, routine feedback regarding such activities as control entries, computer processing, and print requests. [Source: MIL-STD-1801, 4.6.3.1]

- **8.17.10.2 User control.** When appropriate, users should be able to specify the level or type of system message they want to receive. [Source: DOE HFDG ATCCS, V2.0, 14.13.6, DOD HCISG V2.0, 8.2.13.6]

- **8.17.10.3 Clarity of purpose.** The wording of routine messages should make clear to the user that they provide status or feedback information, not that they indicate errors or requests for a user action. [Source: DOE HFDG ATCCS, V2.0, 14.13.5, DOD HCISG V2.0, 8.2.13.5]

8.17.11 Error management

8.17.11.1 General

- **8.17.11.1.1 User-detected errors.** A user should be able to stop a control process at any point in a sequence to correct an error. [Source: MIL-HDBK-761A, 5.1.10.a]

- **8.17.11.1.2 Appropriate response to all entries.** A system or application shall provide an appropriate response to all possible control entries, correct and incorrect. [Source: MIL-HDBK-761A, 5.1.10.b; DOE HFDG ATCCS, V2.0, 2.5.11]

  Example. The selection of an incorrect function key might result in a message listing the appropriate selections. [Source: MIL-HDBK-761A, 5.1.10.b; DOE HFDG ATCCS, V2.0, 2.5.11]

- **8.17.11.1.3 System detection of error type.** A system or application should be able to distinguish among program errors, equipment failures, and operator errors and, if a failure results in a shutdown, allow for minimum loss of work performed. [Source: MIL-HDBK-761A, 5.1.10.c]

- **8.17.11.1.4 Fast error detection.** User errors should be detected and reported by the system as soon as possible so that they can be corrected in a timely manner. [Source: DOE HFDG ATCCS, V2.0, 2.5.10]

- **8.17.11.1.5 Immediate data correction.** When a user has completed a data entry transaction and an error is detected, the user shall be able to make corrections directly and immediately. [Source: DOE HFDG ATCCS, V2.0, 2.5.8]

- **8.17.11.1.6 Prompting command correction.** When a system or application does not recognize an element of a command entry, the system should prompt the user to correct that element rather than require reentry of the entire command. [Source: DOE HFDG ATCCS, V2.0, 2.5.7]

- **8.17.11.1.7 Display duration.** Notices, alerts, and informational displays should remain visible to a user until he or she responds with an appropriate action. [Source: DOE HFDG ATCCS, V2.0, 2.5.13]

- **8.17.11.1.8 Enter action for corrections.** A system or application shall require an explicit user action to reenter corrected material after a user has completed correcting an error. [Source: MIL-HDBK-761A, 5.1.10.3.b; DOE HFDG ATCCS, V2.0, 2.5.6; MIL-STD-1801, 4.2.4.4]

- **8.17.11.1.9 User action for reentry.** The enter action for reentry of corrected items shall be the same as the enter action for the original entry. [Source: MIL-HDBK-761A, 5.1.10.3.b; DOE HFDG ATCCS, V2.0, 2.5.6; MIL-STD-1801, 4.2.4.4]

- **8.17.11.1.10 Return to main interaction.** A system or application shall provide an easy means to return to the previous page after error correction. [Source: MIL-HDBK-761A, 5.1.10.3.c]

- **8.17.11.1.11 User confirmation of destructive actions.** When a control entry (including log off) will result in a change in stored data, procedures, or system operation (particularly if it is not easily reversible), the system or application shall explicitly notify the user of the potential loss of data, and require a confirmation before implementing the action. [Source: DOE HFDG ATCCS, V2.0, 2.5.1, 2.5.2, 2.5.9; MIL-STD-1801, 4.2.4.5, 4.2.4.6]

- **8.17.11.1.12 Confirmation key for destructive actions.** The **Enter** key shall not be used for confirmation of destructive actions. [Source: DOE HFDG ATCCS, V2.0, 2.5.1, 2.5.2, 2.5.9; MIL-STD-1801, 4.2.4.5, 4.2.4.6]

- **8.17.11.1.13 Flexible "go back" for error correction.** A system or application shall allow a user to go back easily to previous steps in a transaction sequence in order to correct an error or make any other desired change. [Source: DOE HFDG ATCCS, V2.0, 2.5.5]

- **8.17.11.1.14 Undo control action.** A system or application should provide an **Undo** operation that immediately reverses the last previous control action. [Source: DOE HFDG ATCCS, V2.0, 2.5.10; MIL-STD-1801, 4.2.4.7; CTA, 1996 - 2.4.1.2]

- **8.17.11.1.15 Reversing undo.** A second **Undo** action that reverses an original **Undo** action should be provided to reinstate whatever was just undone. [Source: DOE HFDG ATCCS, V2.0, 2.5.10; MIL-STD-1801, 4.2.4.7; CTA, 1996 - 2.4.1.2]

- **8.17.11.1.16 Error recovery.** All conditions and information relevant for user recovery from an error shall be displayed to the user. [Source: DOE HFDG ATCCS, V2.0, 2.5.10; MIL-STD-1801, 4.2.4.7]

- **8.17.11.1.17 Timeliness of error feedback.** Error messages and error feedback about the data or control entry shall be given within 2 to 4 seconds after the user completes the entry in which the error is detected. [Source: DOE HFDG ATCCS, V2.0, 2.5.10; MIL-STD-1801, 4.2.4.7]

8.17.11.2 Error messages

- **8.17.11.2.1 System-detected need for help.** To the extent practicable, a system or application should detect inappropriate user entries and actions, automatically interrupt the task, and either suggest an appropriate entry or action or ask the user to confirm or clarify his or her intentions. [Source: DOE HFDG ATCCS, V2.0, 14.13; DOD HCISG V2.0, 8.2.1.2, 8.2.13]

  Examples. The system might provide a message when it detects an error, an out-of-range response, a missing parameter, a duplicated entry, or an unusually long pause on the part of the user. [Source: DOE HFDG ATCCS, V2.0, 14.13; DOD HCISG V2.0, 8.2.1.2, 8.2.13]

- **8.17.11.2.2 Confirmation messages.** When a user entry might cause the loss or destruction of data or a disruption of a system, the system shall display a cautionary message and require that the user confirm the entry. [Source: DOE HFDG ATCCS, V2.0, 14.13.3; DOD HCISG V2.0, 8.2.13.3; MIL-STD-1801, 4.6.4.7]

- **8.17.11.2.3 Multilevel messages.** When appropriate, the system shall provide more than one level of error messages with successive levels providing increasingly detailed levels of explanation. [Source: MIL-STD-1801, 4.6.4.2]

- **8.17.11.2.4 Multiple errors.** When a system detects multiple errors, it should describe the first error and inform the user of the total number of additional errors, move the cursor to the location of the first error, and, when appropriate, provide a means for the user to request sequential display of the additional error messages. [Source: MIL-STD-1801, 4.6.4.3]

- **8.17.11.2.5 Non-disruptive error messages.** The display of error messages should not disrupt ongoing user activity. [Source: MIL-STD-1801, 4.6.4.4]

  Example. An error message should not be displayed until a user has completed an entry. [Source: MIL-STD-1801, 4.6.4.4]

- **8.17.11.2.6 Coding of error messages.** Messages that require special user attention shall be coded appropriately and distinctively. [Source: MIL-STD-1801, 4.6.4.3]

- **8.17.11.2.7 Content of error messages.** When applicable, error messages should state the error detected, the input field containing the error, and the corrective action. [Source: Ameritech Services Inc., 1996 - 5.3.1]

  Example. When the user enters a date in the incorrect format, the messages would read, "Format is MM/DD/YY." [Source: Ameritech Services Inc., 1996 - 5.3.1]

- **8.17.11.2.8 Additional information.** The user should be permitted to request a more detailed explanation of the error and additional information about the ongoing operation. [Source: DOE HFDG ATCCS, V2.0, 14.13.4; DOD HCISG V2.0, 8.2.13.4; CTA, 1996 - 8.3.4]

  Example. An error message could have a **Show more** push button.

- **8.17.11.2.9 Wording of error messages**. Error messages shall be brief, specific, and task-oriented. [Source: MIL-STD-1801, 4.6.4.1]

- **8.17.11.2.10 Specificity of error messages.** Error messages shall provide information that pertains specifically to the operation of the task instead of offering general information. [Source: Ameritech Services Inc., 1996 - 5.3.1]

  Discussion. Make the user aware of the consequences of an action before suggesting that action. For example, say "To delete text, press Enter" instead of "Press Enter to delete text." [Source: Ameritech Services Inc., 1996 - 5.3.1]

- **8.17.11.2.11 Tone of error messages.** In general, error messages should be worded as advice or suggestions. [Source: DOE HFDG ATCCS, V2.0, 14.13.2; DOD HCISG V2.0, 8.2.13.2]

- **8.17.11.2.12 Correcting errors.** When possible, after detecting an error, users should not have to reenter the entire entry, only the portion of the entry or command that is in error. [Source: MIL-STD-1801, 4.6.4.6]

- **8.17.11.2.13 Cursor placement.** After an error message is displayed, the cursor shall be placed at the location of the error. [Source: MIL-STD-1801, 4.6.4.5]

- **8.17.11.2.14 Instructions and error messages.** Instructions and error messages shall appear in a consistent location on the screen. [Source: DOD HCISG V2.0, 4.2.1.4]

8.17.11.3 Command interaction errors

- **8.17.11.3.1 Command editing.** A system or application shall permit a user to edit an extended command during its composition before taking an explicit **Enter** action. [Source: MIL-HDBK-761A, 5.1.10.a; MIL-STD-1801]

- **8.17.11.3.2 Command correction prompting.** A system or application shall prompt a user to correct an element of a command entry that is not recognized or that is logically inappropriate. [Source: MIL-HDBK-761A, 5.1.10.3.a; MIL-STD-1801, 4.2.4.2]

- **8.17.11.3.3 Faulty commands.** Whenever possible, a faulty command shall be retained in the command entry area of the display, with the cursor automatically positioned at the incorrect item and an advisory message displayed that describes the problem. [Source: MIL-HDBK-761A, 5.1.10.3.a; MIL-STD-1801, 4.2.4.2]

- **8.17.11.3.4 Unrecognized commands.** When a menu selection, function key, or command entry is invalid or inoperative at the time of selection, no action should result except the display of an advisory message telling the user what is wrong and which functions, options, or commands are appropriate. [Source: MIL-HDBK-761A, 5.1.10.1.c]

- **8.17.11.3.5 Errors in stacked commands.** When an error is detected in a series of stacked command entries, the system shall operate consistently in one of the following modes: (1) execute commands up to the point of error or (2) require the user to correct any errors before executing any of the commands. [Source: MIL-HDBK-761A, 5.1.10.1.b; DOE HFDG ATCCS, V2.0, 2.5.3]

- **8.17.11.3.6 Partial execution of stacked commands.** When only a portion of a stack of commands can be executed, the system or application shall notify the user and provide appropriate guidance to permit correction, completion, or cancellation of the command. [Source: DOE HFDG ATCCS, V2.0, 2.5.4]

- **8.17.11.3.7 Stacked command execution.** When the system detects an error in a stack of commands it is processing, it shall notify the user and promptly (within 4 sec) provide guidance to permit correction, completion, or cancellation of the stacked commands. [Source: MIL-HDBK-761A, 5.1.10.1.a; MIL-STD-1801, 4.2.4.3]

- **8.17.11.3.8 Repeated errors.** When an error is repeated, causing the same error message to be repeated in succession, the message should be reworded for the third repetition and all following error messages that apply to that error. [Source: Ameritech Services Inc., 1996 - 5.3.2.2]

8.17.12 Data validation

- **8.17.12.1 Validation on input.** To the extent possible, the system should validate graphic information as it is created by providing a message when a given value is outside the standard range. [Source: MIL-HDBK-761A, 5.2.6.d]

- **8.17.12.2 Format and content.** When possible, the system should automatically check data for format and content. [Source: MIL-HDBK-761A, 5.2.7.2.a]

  Example. A date entered as February 31 will result in a content error message. [Source: MIL-HDBK-761A, 5.2.7.2.a]

- **8.17.12.3 Valid data.** Valid data entries should be accepted and processed without any further user action. [Source: MIL-HDBK-761A, 5.2.7.2.b]

- **8.17.12.4 Invalid data.** Data and command entries that do not meet validation testing should result in a message asking for correction or confirmation. [Source: MIL-HDBK-761A, 5.2.7.2.c]

- **8.17.12.5 Probable errors.** When validation testing detects a probable error, an error message should be displayed at the completion of the data entry without interrupting an ongoing transaction. [Source: MIL-HDBK-761A, 5.2.7.2.d]

8.18 Help

8.18.1 On-line help

On-line Help can provide procedural aids, the ability to recover from errors, and advice without requiring a user to exit from the application. Ideally, on-line Help is always available and sensitive to the context within which it is requested. [Source: DOD HCISG V2.0, 14.1.1, 14.1.3]

Definition. On-line Help is primarily an interactive, context-sensitive source of information that can tell a user what entry to make at the current location in an application, what keystrokes are required, or what steps are required to complete a task. Secondarily, on-line Help is a form of on-line documentation and reference information. [Source: DOD HCISG V2.0, 14.1.1, 14.1.3]

An on-line Help facility may provide any or all of three types of Help: advice, active Help, and passive Help.

Advice is an interactive, context-sensitive source of information that indicates what entry to make at the current location in the application, the required keystroke(s), or which steps to take to complete the task. [Source: DOD HCISG V2.0, 14.1.1, 14.1.3]

Active Help senses an inappropriate entry and interrupts the task to ask users what they are attempting and if they are sure they want to complete the operation they have just initiated. Depending upon the user response to the question, active Help then suggests the correct action. [Source: DOD HCISG V2.0, 14.1.1, 14.1.3]

Passive Help simply responds to user requests for information. The information may be in the form of on-line system documentation, such as a user's guide or a list of functions performed by combinations of key presses. [Source: DOE HFDG ATCCS, V2.0, 8.5.2]

8.18.2 General

- **8.18.2.1 Availability of on-line Help.** Specific user guidance information should be available on-line for display at any point in a transaction sequence. [Source: DOE HFDG ATCCS, V2.0, 14.3.1; MIL-HDBK-761A, 5.4.2.2; DOD HCISG V2.0, 8.2.3.1; MIL-STD-1801, 4.6.5.1]

- **8.18.2.2 Automatic Help.** The Help function should be activated automatically (offering Help) when the user is making repeated errors. [Source: CTA, 1996 - 2.8.6]

- **8.18.2.3 On-line guidance.** The system should provide users with appropriate on-line data, command indexes, and dictionaries to guide them in the selection and composition of data and command entries. [Source: MIL-STD-1801, 4.6.5.4]

- **8.18.2.4 Content of on-line guidance.** On-line guidance material should include all applicable definitions, lists of allowable entries, ranges of acceptable values, and reference material describing system capabilities and procedures. [Source: MIL-STD-1801, 4.6.5.4]

- **8.18.2.5 User-centered Help.** On-line Help should be user-centered, that is, based on the task the user is trying to complete and not on the characteristics of the application. [Source: DOD HCISG V2.0, 8.2.5.6; DOE HFDG ATCCS, V2.0, 14.5.6]

- **8.18.2.6 User-requested Help on errors.** When an error occurs and the user requests Help, the Help should provide a useful description of the error and suggest at least one recovery technique. [Source: CTA, 1996 - 8.5.3.3]

- **8.18.2.7 Consistent and distinguishable formats.** User guidance shall be displayed consistently in a format that is distinguishable from that of other displayed data. [Source: DOD HCISG V2.0, 8.2.8.1; MIL-HDBK-761A, 5.4.1.2.a]

- **8.18.2.8 Location of displayed Help.** To the extent possible, the display of Help should not obscure the object about which Help was requested. [Source: DOD HCISG V2.0, 8.2.6.4, 8.2.6.5; DOE HFDG ATCCS, V2.0, 14.6.4, 14.6.5]

- **8.18.2.9 Duration of on-line Help.** On-line Help shall remain visible until the user chooses to remove it. [Source: Ameritech Services Inc., 1996 - 5.3.4]

- **8.18.2.10 Printing Help information.** Users should be able to print displayed Help information. [Source: DOD HCISG V2.0, 8.2.12.1.c; DOE HFDG ATCCS, V2.0, 14.12.2; MIL-STD-1801, 4.6.5.4]

- **8.18.2.11 Searching on-line Help.** Users shall be able to search through on-line Help displays. [Source: MIL-STD-1801, 4.6.5.5.c]

- **8.18.2.12 User annotations.** Users should be able to annotate existing Help messages. [Source: DOE HFDG ATCCS, V2.0, 14.7.3; DOD HCISG V2.0, 8.2.7.3]

- **8.18.2.13 Synonyms for standard terminology.** When a user requests Help on a topic, the computer should accept synonyms and abbreviations. [Source: Nuclear Regulatory Commission, 1996 - 2.4.6-5]

- **8.18.2.14 Clarifying Help requests.** When a request for Help is ambiguous in content, the computer should initiate a dialogue to specify what data, message, or command requires explanation. [Source: Nuclear Regulatory Commission, 1996 - 2.4.6-7]

- **8.18.2.15 User requests.** Users should be able to request Help on selected topics. [Source: DOE HFDG ATCCS, V2.0, 14.7.1; DOD HCISG V2.0, 8.2.7.1]

- **8.18.2.16 Help availability.** Both system-level and application-level Help should be available to users and provided in the following ways:

  a. As a menu title in the system menu bar. This level of Help should describe system capabilities and provide information on how to use Help. It may include an on-line tutorial for users and a system navigation aid.

  b. As a menu title in an application menu bar. This level of Help should include general information on application functionality. It may include an on-line, cross-referenced index so that users can obtain information about particular windows, actions, and commands. When the application uses action icons, it may provide Help through an action icon.

  c. As a push button or check box in a window. This level of Help should provide information about the actions that can be taken in the window.

  d. As a message in the message area of a window. This level of Help should explain how to complete the initiation of an action.

  e. As a function available from the keyboard. This level of Help should provide information about the object in a window that has input focus. The information may be displayed in a message window or in the message area of the window in which the object appears. [Source: DON UISNCCS, V1.2, 9.1.1]

8.18.3 Access and return

- **8.18.3.1 Access from and return to application.** Users should be able to access Help from within an application, (i.e., without leaving the application), and return to where they were before requesting Help. [Source: DOD HCISG V2.0, 8.2.6.3; DOE HFDG ATCCS, V2.0, 14.6.3]

- **8.18.3.2 Help icon and function key.** The system or application should place a Help icon on the screen and designate a function key as the Help key. [Source: CTA, 1996 - 8.5.3.5]

- **8.18.3.3 Use of Help icon and function keys.** Systems and applications should use the Help icon and the Help key consistently throughout the application. [Source: CTA, 1996 - 8.5.3.5]

- **8.18.3.4 Reminder of accessibility.** Users should be provided with a constant reminder of **Help** availability. [Source: DOD HCISG V2.0, 8.2.3.2; DOE HFDG ATCCS, V2.0, 14.3.2]

  Example. This might be accomplished by the display of the word **Help** in a menu bar or by displaying a push button labeled **Help**. [Source: DOD HCISG V2.0, 8.2.3.2; DOE HFDG ATCCS, V2.0, 14.3.2]

- **8.18.3.5 Notification of unavailability of Help.** When **Help** is not always available, users should be informed when it is not available. [Source: DOD HCISG V2.0, 8.2.3.3; DOE HFDG ATCCS, V2.0, 14.3.3]

  Example. Dimming a Help label might do this. [Source: DOD HCISG V2.0, 8.2.3.3; DOE HFDG ATCCS, V2.0, 14.3.3]

- **8.18.3.6 Standard action.** Users should be able to obtain on-line Help by using a standard action that is always available. [Source: MIL-HDBK-761A, 5.4.2.1.a]

- **8.18.3.7 Consistent access.** The procedures for accessing on-line Help should be consistent throughout an application and related applications. [Source: DOD HCISG V2.0, 8.2.8.2; DOE HFDG ATCCS, V2.0, 14.8.1]

- **8.18.3.8 Easy access.** Users should not be required to memorize lengthy sequences or refer to secondary written procedures to access on-line Help. [Source: MIL-HDBK-761A, 5.4.2.2.2.f]

- **8.18.3.9 Help command.** The system shall provide a **Help** command that allows users to obtain on-line guidance information. [Source: MIL-STD-1801, 4.6.5.5]

- **8.18.3.10 Easy alternation between Help display and original display.** Users should be able to alternate easily between a Help display and the display from which Help was requested. [Source: MIL-HDBK-761A, 5.4.1.1.d]

- **8.18.3.11 Easy return.** After requesting and receiving Help, a user should be provided with an easy means to return to the display from which Help was requested. [Source: DOD HCISG V2.0, 8.2.10.2; DOE HFDG ATCCS, V2.0, 14.10.1, 14.10.2; MIL-HDBK-761A, 5.4.2.1.e]

- **8.18.3.12 Control options.** Any Help or guidance display should include any relevant control options. [Source: MIL-HDBK-761A, 5.4.2.2.2.c]

  Example. A Help window might include an **OK** push button for removing the window. [Source: MIL-HDBK-761A, 5.4.2.2.2.c]

- **8.18.3.13 Single action.** Users shall be able to access and exit **Help** with a single action, for example, a single keystroke or a single click of a pointing device. [Source: DOD HCISG V2.0, 8.2.2.1, 8.2.3.4, 8.2.10.1; DOE HFDG ATCCS, V2.0, 14.3.4]

- **8.18.3.14 Marking topics for retrieval.** When the number of topics in an on-line Help facility is large and if it would be useful to users to be able to customize the facility by marking individual topics for retrieval, the facility should provide this capability. That is, allow users to be able to mark individual topics and then retrieve only the marked topics. [Source: DOD HCISG V2.0, 8.2.12.1; DOE HFDG ATCCS, V2.0, 14.2.1]

- **8.18.3.15 Synonyms.** Synonyms for standard terminology should be recognized by Help routines, requiring only that the user enter a term for which they are interested in obtaining Help. [Source: Ameritech Services Inc., 1996 - 5.3.4.1; MIL-HDBK-761A, 5.4.2.1.b]

- **8.18.3.16 Misspelled words.** When a user enters a term for which they are interested in obtaining Help, the application should accept close spelling matches. [Source: Ameritech Services Inc., 1996 - 5.3.4.1; MIL-HDBK-761A, 5.4.2.1.b]

8.18.4 Context sensitivity

- **8.18.4.1 Task-oriented Help.** The information provided in response to a **Help** request shall be relevant to the task and the current transaction within the task. [Source: MIL-HDBK-761A, 5.4.2.1.d; MIL-STD-1801, 4.6.5.5.a]

- **8.18.4.2 Ambiguous context.** When the context in which a request for Help is made is ambiguous, the system should initiate a dialog in which the user can specify what data, message, or command requires explanation. [Source: MIL-HDBK-761A, 5.4.1.2.d]

- **8.18.4.3 Context information in Help display.** When a user's request for Help depends upon the context established by previous entries, an indication of that context should be included in the Help display. [Source: MIL-HDBK-761A, 5.4.2.2.2.e (2)]

- **8.18.4.4 List valid entries.** When a user makes an invalid entry, the system should provide a list of valid entries. [Source: Ameritech Services Inc., 1996 - 5.3.2.1; DOD HCISG V2.0, 8.2.6.2; DOE HFDG ATCCS, V2.0, 14.6.2]

  Example. If the user types PITTABURGH, offer a list of suggested choices that would allow the user to make a correction without having to re-key the entry. [Source: Ameritech Services Inc., 1996 - 5.3.2.1; DOD HCISG V2.0, 8.2.6.2; DOE HFDG ATCCS, V2.0, 14.6.2]

- **8.18.4.5 Historical context.** When appropriate, users should be able to request a displayed record of past transactions. [Source: MIL-HDBK-761A, 5.4.2.2.2.f (2)]

8.18.5 Wording and style

- **8.18.5.1 Wording.** The following practices should be applied in wording Help information.

  a. The most important information should be placed at the beginning of each on-line Help message.

  b. Messages should be stated in short, simple sentences that are consistently structured in the active instead of passive voice.

  c. Messages should be positively worded. Negative statements should only be used for stating exceptions to rules.

  d. Common words with apparent meanings should be used. Abbreviations or contractions should not be used. [Source: Ameritech Services Inc., 1996 - 5.5.1.1]

- **8.18.5.2 Appropriate to user.** Help information shall be appropriate to the experience and training of the system users. [Source: DOD HCISG V2.0, 8.2.9.4]

  Discussion. When appropriate, Help messages may incorporate special terms and technical jargon that is well understood and employed in the user's task environment.

- **8.18.5.3 Visual style.** The visual style of on-line Help should maintain a great deal of white space with no more than 40% of the pixels used for words and figures. [Source: Ameritech Services Inc., 1996 - 5.3.4.1].

8.18.6 Content

- **8.18.6.1 Scope.** On-line Help should include: (1) memory aids, (2) basic information likely to be of use only to novices, (3) material selected from written documentation, (4) explanations that go beyond written documentation, (5) information that might seem obvious but may not be to all users, and (6) step-by-step instructions on how to perform the most common tasks. [Source: DOE HFDG ATCCS, V2.0, 14.2.2, 14.2.6; DOD HCISG, V2.0, 8.2.2.2, 8.2.2.6, 8.2.2.9]

- **8.18.6.2 Only relevant information.** Help displays should contain only information relevant to the current requirements of the user. [Source: DOE HFDG ATCCS, V2.0, 14.9.3; DOD HCISG, V2.0, 8.2.9.3]

- **8.18.6.3 Multilevel Help.** The system should provide multiple levels of Help with successive levels providing increasingly detailed levels of explanation. [Source: MIL-HDBK-761A, 5.4.2.1.c; MIL-STD-1801, 4.6.5.5.b]

- **8.18.6.4 Help on Help.** On-line Help should include Help on how to use the on-line Help which includes

  a. a description of all Help displays;

  b. instructions on how to access Help from anywhere in the system, including alternative routes, if any;

  c. instructions on navigating through Help, including scrolling, paging, and moving to related topics, and

  d. a description of the current window, including its function and any tasks the user can perform. [Source: DOE HFDG ATCCS, V2.0, 14.9.1, 14.9.2; DOD HCISG, V2.0, 8.2.9.2]

- **8.18.6.5 Titles.** Each **Help** display shall have a title that identifies its contents and reflects the location from which it originated. [Source: DOE HFDG ATCCS, V2.0, 14.9.1, 14.9.2; DOD HCISG, V2.0, 8.2.9.1, 8.2.9.2]

- **8.18.6.6 System information.** On-line Help should include a description of system capabilities and procedures. [Source: MIL-HDBK-761A, 5.4.2.2.2.e]

- **8.18.6.7 Application information.** On-line Help should include a description of the application, including its capabilities, components, options, and structure. [Source: DOD HCISG, V2.0, 8.2.5]

- **8.18.6.8 Available commands.** When an application uses commands, an on-line index and description of all commands should be available. [Source: DOE HFDG ATCCS, V2.0, 14.4.2; DOD HCISG, V2.0, 8.2.4.2; MIL-HDBK-761A,5.4.2.2.2.b]

- **8.18.6.9 Command examples.** When appropriate, Help displays should include examples of correct input or valid commands which include realistic commands and parameters, not just formal syntax. [Source: DOE HFDG ATCCS, V2.0, 14.5.4; DOD HCISG, V2.0, 8.2.5.4]

- **8.18.6.10 Command format.** When appropriate, Help displays should include a description of the format of a specified command and a list of allowable commands. [Source: DOE HFDG ATCCS, V2.0, 14.5.5; DOD HCISG, V2.0, 8.2.5.5]

- **8.18.6.11 Function keys.** On-line Help should provide multilevel descriptions of the actions assigned to function keys. [Source: DOD HCISG, V2.0, 8.2.6.6]

- **8.18.6.12 Prompts, requests, and definitions.** On-line Help should provide multilevel Help on any displayed prompts or requests and definitions of all-important terms. [Source: DOE HFDG ATCCS, V2.0, 14.5.3; DOD HCISG, V2.0, 8.2.5.3]

- **8.18.6.13 Error messages.** On-line Help should provide multilevel Help on error messages. [Source: DOE HFDG ATCCS, V2.0, 14.5.2; DOD HCISG, V2.0, 8.2.5.2]

- **8.18.6.14 Shortcuts.** On-line Help should point out shortcuts and infrequently used features to users. [Source: DOE HFDG ATCCS, V2.0, 14.5.1; DOD HCISG, V2.0, 8.2.5.1]

- **8.18.6.15 Help index.** An on-line index of Help topics should be available to users. [Source: DOE HFDG ATCCS, V2.0, 14.4.1; DOD HCISG, V2.0, 8.2.4.1; MIL-HDBK-761A,5.4.2.2.2.d(2)]

- **8.18.6.16 Finding Help topics.** The on-line Help facility should allow users to press any alphabetic key and obtain a list of the Help topics beginning with that letter, and then allow the users to select a topic from the list and obtain the Help information for that topic. [Source: DOE HFDG ATCCS, V2.0, 14.7.4; DOD HCISG, V2.0, 8.2.7.4]

8.18.7 Help windows

- **8.18.7.1 Help window elements.** A **Help** window should include a title that identifies the contents, a working area that displays the **Help** information, and an **OK** push button to remove the window. [Source: DON UISNCCS, V1.2, 9.1.2]

- **8.18.7.2 Printing the Help window.** Users should be able to print part or all of the contents of a **Help** window. [Source: DON UISNCCS, V1.2, 9.1.2]

- **8.18.7.3 Size. Help** windows should be wide enough to display complete lines of text and long enough to display all the lines, if practical. [Source: DON UISNCCS, V1.2, 9.1.2]

- **8.18.7.4 Placement.** The **Help** window should be placed so that it does not obscure the object it describes. [Source: DOD HCISG V2.0, 8.2.6.4, 8.2.6.5; DOE HFDG ATCCS, V2.0, 14.6.4, 14.6.5]

- **8.18.7.5 Help window.** When the **Help** display is in a window, the window should be movable and resizable. [Source: DOD HCISG V2.0, 8.2.6.4, 8.2.6.5; DOE HFDG ATCCS, V2.0, 14.6.4, 14.6.5]

- **8.18.7.6 Help information.** A **Help** window should describe the object or explain the steps required to initiate the action about which **Help** was requested. [Source: DON UISNCCS, V1.2, 9.1.3]

- **8.18.7.7 Removal of Help windows. Help** windows should be removed from the screen either at the users request or when the object or window about which **Help** was requested is removed, minimized, or closed. [Source: DON UISNCCS, V1.2, 9.1.3]

- **8.18.7.8 Keeping a Help window open.** Users should be able to keep a **Help** window displayed while continuing to work with the application. [Source: DON UISNCCS, V1.2, 9.1.3]

8.19 Data communication

Although the computer-human interface guidelines in the previous sections apply to data communication software as well, there are some guidelines that are specific to data application programs. The guidelines presented in this section are those specific to data communication applications and should be considered in addition to the guidelines of the previous section.

8.19.1 General

- **8.19.1.1 Consistent procedures.** Procedures for preparing, sending, and receiving messages shall be consistent within and across data communication applications. [Source: MIL-HDBK-761A, 5.6.1.1.b]

- **8.19.1.3 Message handling windows.** Windows intended for sending and receiving electronic messages shall conform to the general criteria and guidelines for data entry windows [Source: DON UISNCCS, V1.2, 9.7.1]

- **8.19.1.4 Message display.** When a message is displayed, it should appear in a text window with all the capabilities of these windows such as scrolling and printing. [Source: DON UISNCCS, V1.2, 9.7.3]

- **8.19.1.5 Explicit user actions.** Both sending and receiving of messages shall be accomplished by explicit user action. [Source: MIL-HDBK-761A, 5.6.1.1.d]

- **8.19.1.6 Interruptible by user.** Users should be able to interrupt message preparation or review. [Source: MIL-HDBK-761A, 5.6.1.1.f]

- **8.19.1.7 Resuming activity.** The user should be able to resume message preparation or review from the point of interruption. [Source: MIL-HDBK-761A, 5.6.1.1.f]

- **8.19.1.8 Printing messages.** Users should be able to print copies of transmitted messages. [Source: MIL-HDBK-761A, 5.6.3.1.4.c]

8.19.2 Preparing messages

- **8.19.2.1 User-designed format.** Unless a need exists for a specific message format, users should be able to compose and transmit messages as unformatted text or with a format of their own design. [Source: MIL-HDBK-761A, 5.6.2.3.a]

- **8.19.2.2 Application-supplied format.** When messages must conform to a defined format, a preformatted message form shall be available to users. [Source: MIL-HDBK-761A, 5.6.2.3.b]

- **8.19.2.3 Incorporating existing data.** Users should be able to incorporate existing file data (including other messages received or transmitted) into messages. [Source: MIL-HDBK-761A, 5.6.2.2.a]

- **8.19.2.4 Saving prepared messages.** Users should be able to save draft messages during preparation and after completion. [Source: MIL-HDBK-761A, 5.6.2.2.c]

8.19.3 Sending messages

- **8.19.3.1 User initiation of data transmission.** Data transmission should be initiated by an explicit user action, (e.g., a **Send** command). [Source: MIL-HDBK-761A, 5.6.3.2.2.a]

- **8.19.3.2 What users can transmit.** Users should be able to transmit both information that is displayed on their screens and information stored in files. [Source: MIL-HDBK-761A, 5.6.3.2.2.b]

- **8.19.3.3 Appended information.** When a message is sent, the sender's address and the date and time of message creation and transmission should be appended automatically. [Source: National Air Traffic Services, 1999 - 1.12.14.9.2]

- **8.19.3.4 Transmitted message log.** A record of transmitted messages should automatically be maintained. [Source: MIL-HDBK-761A, 5.6.3.2.2.c]

- **8.19.3.5 Canceling unsent messages.** Users should be able to cancel or abort any message that has not yet been transmitted. [Source: DON UISNCCS, V1.2, 9.7.2]

- **8.19.3.6 Automatic message queuing.** Outgoing messages should be automatically queued pending transmission. [Source: National Air Traffic Services, 1999 – 1.12.14.9.5]

- **8.19.3.7 Specifying message priority.** Users should be able to assign a priority to a message. [Source: National Air Traffic Services, 1999 – 1.12.14.9.6]

- **8.19.3.8 Automatic assignment of priority.** When the user does not specify a priority preference, the system should assign priority automatically. [Source: National Air Traffic Services, 1999 - 1.12.14.9.6]

- **8.19.3.9 Notification of delivery.** Users should be able to request notification that a message has been opened by the addressee. [Source: MIL-HDBK-761A, 5.6.3.2.2.d]

- **8.19.3.10 Notification of unsuccessful transmission.** Users shall be notified if a message could not be transmitted. [Source: DON UISNCCS, V1.2, 9.7.2]

- **8.19.3.11 Notification of transmission failure.** When possible, notification of failure to transmit a message should include an explanation of the failure. [Source: MIL-HDBK-761A, 5.6.3.4.b]

- **8.19.3.12 Storage of undelivered message.** When message transmission fails, automatic storage of undelivered messages should be provided. [Source: MIL-HDBK-761A, 5.6.3.4.b]

- **8.19.3.13 Automatic re-send.** When transmission is unsuccessful due to line unavailability, the system should automatically make repeated attempts to send the message. [Source: DON UISNCCS, V1.2, 9.7.2]

8.19.4 Addressing messages

- **8.19.4.1 User-specified destinations.** Users should be able to specify destinations to which data will be transmitted. [Source: National Air Traffic Services, 1999 – 1.12.14.9.3]

  Discussion. Destinations may include individuals, groups of individuals, workstations, terminals, and remote printers.

- **8.19.4.2 Editing address fields.** Users should be able to edit the address fields in the header of a message being prepared for transmission. [Source: MIL-HDBK-761A, 5.6.3.1.1.b]

- **8.19.4.3 Message window fields and headers.** Message handling windows should include a basic set of labeled fields, including **Date, From,** and **Time** and an addressee field, a copy to field, a subject field, and a message field which are interpretable by all systems to which messages can be sent. [Source: DON UISNCCS, V1.2, 9.7.1; MIL-HDBK-761A, 5.6.3.1.2.a]

- **8.19.4.4 Field support.** The application should provide information to help a user make a proper entry in a field. [Source: DON UISNCCS, V1.2, 9.7.1]

  Example. Prompting can be provided to guide the user in specifying the address for a message. [Source: MIL-HDBK-761A, 5.6.3.1.2.b]

- **8.19.4.5 Address directory.** Users should be able to select addresses from a directory for automatic entry in address fields. [Source: MIL-HDBK-761A, 5.6.3.1.3.a]

- **8.19.4.6 Directory search.** Users should be able to search for addresses in a directory by specifying a complete or partial name or other address information. [Source: MIL-HDBK-761A, 5.6.3.1.3.a]

- **8.19.4.8 Substitute addresses.** Users should be able to define substitute addresses for commonly used addresses and use these substitutes to address messages. [Source: MIL-HDBK-761A, 5.6.3.1.3.b]

  Example. A user might define jane as the address "jdoe@tc.faa.gov." [Source: MIL-HDBK-761A, 5.6.3.1.3.b]

- **8.19.4.9 Automatic addressing of replies.** When a user replies to a message, the messaging system should provide the appropriate address(s) automatically. [Source: MIL-HDBK-761A, 5.6.4.6]

- **8.19.4.10 Distribution lists.** Users should be able to create, store, retrieve, edit, and use distribution lists of commonly used addressees or groups of addressees. [Source: DON UISNCCS, V1.2, 9.7.1]

- **8.19.4.11 Valid address.** The system should ensure that an address is valid. [Source: MIL-HDBK-761A, 5.6.3.1.4.a]

  Examples. When an address is internal to a system, the system might search an on-line directory to validate the address. When an address is external, the system might ensure that the address contains a valid gateway or that the address format is valid. [Source: MIL-HDBK-761A, 5.6.3.1.4.a]

- **8.19.4.12 Error correction.** The system should prompt users to correct any errors it detects before initiating message transmission. [Source: MIL-HDBK-761A, 5.6.3.1.4.b]

8.19.5 Receiving messages

- **8.19.5.1 User control of incoming messages.** Users should be able to specify "filters" based on message source, priority, type, or content that will control the notification of incoming messages.

  Discussion. The use of filters allows the user to specify the order in which received messages can be read and what notification is provided for incoming messages. For example, a user might decide that the arrivals of all messages from a particular sender produce a special notification of some kind.

- **8.19.5.2 User control of incoming messages.** Users should be able to choose the device (files, display, printer) that will receive messages. [Source: MIL-HDBK-761A, 5.6.4.2.a]

- **8.19.5.3 Notification at log on.** Users should be notified at log on of any data transmissions received since their last use of the system. [Source: MIL-HDBK-761A, 5.6.4.5.a]

- **8.19.5.4 Notification during use.** While using the system, users should be notified when they receive a new message. [Source: MIL-HDBK-761A, 5.6.4.5.a and DON UISNCCS, V1.2, 9.7.3]

- **8.19.5.5 Non-interference of notification.** Notification of the arrival of an electronic message should not interfere with ongoing system use. [Source: MIL-HDBK-761A, 5.6.4.5.b]

- **8.19.5.6 Messages with differing priority.** When incoming messages differ in priority, message notification should reflect that priority. [Source: DON UISNCCS, V1.2, 9.7.3]

- **8.19.5.7 Incoming message log.** A log should be maintained of all incoming messages. [Source: MIL-HDBK-761A, 5.6.4.1.b]

- **8.19.5.8 Queuing incoming messages.** Incoming electronic messages should be automatically queued by time of receipt and message priority. [Source: DON UISNCCS, V1.2, 9.7.3]

- **8.19.5.9 User review of message summary information.** Users should be able to review message summary information (e.g., the source, type, and priority) about queued incoming messages. [Source: MIL-HDBK-761A, 5.6.4.3.c]

- **8.19.5.10 Nondestructive review.** Unless precluded by security or other considerations, users should be able to review messages in their inbox without having to save, delete, or respond to them. [Source: MIL-HDBK-761A, 5.6.4.3.b]

- **8.19.5.11 Incoming message operations.** Users should be able to **Display, Save,** and **Delete** individual messages. [Source: DON UISNCCS, V1.2, 9.7.3]

- **8.19.5.12 User specification of summary order.** Users should be able to specify the order in which message summaries are listed. [Source: MIL-HDBK-761A, 5.6.4.3.a]

- **8.19.5.13 Size indication in message summary.** The message summary should include an indication of the size of the message. [Source: MIL-HDBK-761A, 5.6.4.3.f]

- **8.19.5.14 Adding comments to incoming messages.** Users should be able to comment on reviewed messages. [Source: MIL-HDBK-761A, 5.6.4.3.e]

- **8.19.5.15 Display of comments.** Comments should be displayed and should be distinct from the message itself. [Source: MIL-HDBK-761A, 5.6.4.3.e]

- **8.19.5.16 Naming and describing incoming messages.** Users should be able to assign their own names and other descriptors to received messages. [Source: MIL-HDBK-761A, 5.6.4.2.c]

- **8.19.5.17 Disposing of incoming messages.** Users should be able to discard unwanted messages without saving them. [Source: MIL-HDBK-761A, 5.6.4.2.d]

- **8.19.5.18 Data preservation.** The arrival of a message in a format incompatible with that of the system shall not result in the loss of the message or of any ongoing transaction. [Source: MIL-HDBK-761A, 5.6.4.4.b]

- **8.19.5.19 Notification of incompatible format.** When the format of a data transmission is incompatible with the system receiving it (e.g., incompatible with system decoding or with the available devices), the intended recipient should be notified. [Source: MIL-HDBK-761A, 5.6.4.4.a]

8.20 Accommodating people with disabilities

The "Americans with Disabilities Act of 1990" (Public Law 101-336) prohibits employment discrimination against qualified individuals with disabilities. If a person's disability creates a barrier to employment, the Act requires that the employer consider whether reasonable accommodations could remove the barrier. The intent of the Act is to permit people with disabilities to compete with people without disabilities on the basis of the same performance standards and requirements once such accommodations have been made.

Definitions. A **disability** is a physical or mental impairment that substantially limits one or more of a person's major life activities. A **reasonable accommodation** is any modification or adjustment to a job or the work environment that will enable a qualified person with a disability to participate in the application process and to perform essential job functions.

8.20.1 Accommodating people with moderate physical disabilities

- **8.20.1.1 Multiple, simultaneous activations.** When a system requires multiple, simultaneous activations, such as the simultaneous depression of two or more keys on a keyboard, the system should provide an optional, alternative mode of operation. [Source: Scadden & Vanderheiden, 1988, P-1, pp. 13-14]

  Example. One possible alternative mode of operation would accept sequential rather than simultaneous activations. [Source: Scadden & Vanderheiden, 1988, P-1, pp. 13-14]

- **8.20.1.2 Timed responses.** When a system requires a response in less than 5 sec or the release of a key in less than 1.5 sec, the system should provide either a means by which a user can adjust the time interval or an alternate mode that does not have the time requirements. [Source: Scadden & Vanderheiden, 1988, P-2, p. 15]

- **8.20.1.3 Minimal number of "small" targets.** The number of small targets should be minimized, especially if they are likely to be the objects of drag operations. [Source: Casali, Proc. of the HFS, 36, 311-315]

  Discussion. The difficulty of moving a pointer onto an object and moving an object increases as the size of the object decreases. This difficulty is greater for people with disabilities than for people without disabilities. [Source: Casali, Proc. of the HFS, 36, 311-315]

- **8.20.1.4 Zooming capability.** When a small target cannot be avoided, a zooming capability should be provided. [Source: Casali, Proc. of the HFS, 36, 311-315]

8.20.2 Accommodating people with visual disabilities

Most of the difficulty people with visual disabilities have with computer systems arise in connection with output displays. Some difficulty also arises from input devices that require eye-hand coordination.

8.20.2.1 General

- **8.20.2.1.1 Enlarging a display.** People with moderate visual disabilities should be provided a means for enlarging a display [Source: Scadden & Vanderheiden, 1988, V-1, pp. 27-28]

  Discussion. This might be accomplished either by providing a means for attaching a larger display or by providing a means for enlarging all or part of the displayed image. People who are blind usually have most of their difficulty with output displays. Some input devices also cause difficulty, for example, touch screens. [Source: Scadden & Vanderheiden, 1988, V-1, pp. 27-28]

- **8.20.2.1.2 Alternate display of information.** Visually displayed information, both text and graphics, should be available at the alternative output display for people with severe visual disabilities. [Source: Scadden & Vanderheiden, 1988, B-1, pp. 32-33]

8.20.2.2 Auditory screen representation

- **8.20.2.2.1 Granularity.** When a graphical interface is given an auditory representation, the auditory representation should be based on interface objects, not pixels. [Source: Mynatt & Edwards, 1992, 61-70]

- **8.20.2.2.2 Navigation.** Navigation in an auditory representation should move the user's position among different auditory interface objects. [Source: Mynatt & Edwards, 1992, 61-70]

  Discussion. Standard mouse movement is in terms of pixels, which have little or no meaning in an auditory representation. [Source: Mynatt & Edwards, 1992, 61-70]

- **8.20.2.2.3 Auditory and operational consistency.** Each type of object, such as a push button, shall have consistent auditory representation and operate in a consistent way throughout an auditory interface. [Source: Mynatt & Edwards, 1992, 61-70]

- **8.20.2.2.4 Dual representation.** All interactions that a person without visual disabilities would see between the mouse cursor and objects on the screen should have auditory counterparts. [Source: Edwards, 1988, p. 84]

  Discussion. These sounds may be simple or complex tones or patterns of tones, or speech. [Source: Edwards, 1988, p. 84]

- **8.20.2.2.5 Objects represented.** An interface with both visual and auditory representation should incorporate into the auditory portion certain objects when they appear in the corresponding visual interface. These objects are

  a. menus,

  b. windows,

  c. dialogs,

  d. buttons, and

  e. scroll bars. [Source: Edwards, 1988, p. 84]

- **8.20.2.2.6 Eliciting an object's name.** A user should be able to elicit the name of the object currently being selected. [Source: Edwards, 1988, p. 84]

  Example. Pressing one of the buttons of a mouse might result in a synthesized speech announcement of the name of the object. [Source: Edwards, 1988, p. 84]

8.20.3 Accommodating people with hearing disabilities

People who have hearing disabilities and people who are deaf usually have little difficulty using computers. Providing redundant visual outputs to tones and other auditory outputs can eliminate most of the problems they do have.

8.20.3.1 General

- **8.20.3.1.1 Redundant visual output.** All information required for system operation and error detection that is presented in auditory form should also be provided or available redundantly in an appropriate visual form. [Source: Scadden & Vanderheiden, 1988, H-1, pp. 40-41]

- **8.20.3.1.2 Hearing auditory outputs.** Computers and computer systems intended to be accessible to people with hearing disabilities should be designed to maximize the number of users who can hear the auditory outputs. [Source: Vanderheiden & Vanderheiden, 1991, O-1, pp. 20-21]

  Discussion. Auditory information (e.g., synthesized speech, beeps, buzzers, tones, and machine noises) may not be heard well enough to elicit the intended response. Possible solutions include

  a. providing a volume adjustment,

  b. making auditory output as loud as practical,

  c. using sounds that have strong middle- and low-frequency components (500 - 3000 Hz),

  d. providing a headphone jack so that people with hearing disabilities can listen at high volume,

  e. providing a separate volume control for headphone jacks,

  f. placing a sound source on the front of a device and away from sources of loud noise,

  g. facilitating the direct use of the telecoil in hearing aids by including in the equipment a built-in inductive coil to

  h. reducing the amount of non-meaningful sound produced by the equipment, and

  i. presenting auditory information continuously or repetitively until the user responds to it. [Source: Vanderheiden & Vanderheiden, 1991, O-1, pp. 20-21]

- **8.20.3.2.6 Non-overlapping objects.** Objects in an interface that have both visual and auditory representation should not completely obscure other objects, (e.g., a window that completely overlaps another window). [Source: Edwards, 1988, p. 84]

- **8.20.3.2.8 Size and location of objects.** Users should not be able to change the size or move objects that serve as visual symbols of auditory representations. [Source: Edwards, 1988, p. 85]

8.21 Input devices

This section provides criteria and guidelines for keyboards, function keys, pointing devices, and some alternative input devices. The advantages and disadvantages of non-keyboard input devices are shown in Exhibit 8.21. The characteristics of these devices need to be considered in the selection of the appropriate controls for a given task.

Exhibit 8.21 Advantages and disadvantages of non-keyboard input devices

Type of controller	Advantages	Disadvantage
Mouse	Relatively fast Has low error rates for large targets Allows user to concentrate attention on VDT screen	Requires additional flat work surface Difficult to use for free-hand graphic input High error rates with small targets Lost time when mouse held backwards or sideways Some training needed Wheel (ball) slipping sometimes a problem
Directional controllers (joystick and trackball)	Can be used comfortably with minimum arm fatigue Does not cover parts of the screen in use Expansion or contraction of cursor movement is possible Ball control is an efficient use of space	Slower than a light pen and other "point-to devices" for simple input and option selection. Must be attached, but not to the display. Unless there is a large joystick, an inadequate control to display ratio will result for positional control. The displacement of the stick controls both the direction and the speed of cursor movement. Trackball and joystick controllers are difficult to use for accurate free-hand graphic input. Difficult to integrate the activate switch with the trackball.

Exhibit 8.21 (cont.) Advantages and disadvantages of non-keyboard input devices

Exhibit 8.21 (cont.)

Advantages and disadvantages of non-keyboard input devices

Type of controller	Advantages	Disadvantages
Touch screen	No separate input device needed Fast	Low resolution Finger can block view Fingerprints on screen Tires arm
Voice activation	Does not require hands Does not require user to shift gaze Useful for low light conditions Allows simultaneous activation of more than one control mode Could be used in lieu of a translator, allowing natural, conversational version of different languages to control complicated systems	Entry can be slow Must use specified vocabulary Some systems must be individualized to specific user If individual's voice changes (for example, become stressed) system may not respond May require headset Speaker-dependent systems require template loading time

8.21.1 Keyboards

Keyboards vary greatly in the number and arrangement of keys. Most keyboards include the following:

a. Alphanumeric keys. The letters of the alphabet, numerals, and punctuation symbols (numeric keypads may be separate on portable computers).

b. Dedicated formatting keys. Keys for text formatting operations such as a **Space** bar, a **Tab** key, and a **Return** or **Enter** key.

c. Modifier keys. Keys that modify or qualify the effects of other keys for as long as they are held down, for example, **Shift, Ctrl,** and **Alt.**

d. Navigation keys. Keys that move a cursor, for example, **Arrow** keys, **Home, End, Page Up,** and **Page Down.**

e. Fixed-function keys. Keys provided for extra or general functions, typically labeled **F1, F2,** and so on.

f. Special purpose keys. Keys that have a special function, such as **Help, Delete,** and **Backspace.**

- **8.21.1.1 When to use.** If applicable, keyboards shall be provided for the entry of alphabetic, numeric and other special characters into the system. Keyboards shall conform to ANSI/HFS 100-1988, unless otherwise specified or approved by the acquisition program office. [Source: MIL-STD-1472F, 5.14.2.2.1, 5.14.2.2.2]

- **8.21.1.2 Numeric keypads.** If an application requires substantial and repetitive input of numeric data, the keyboard shall include a numeric keypad. [Source: MIL-STD-1472F, 5.14.2.2.5; MIL-STD-1801, 4.1.5.3]

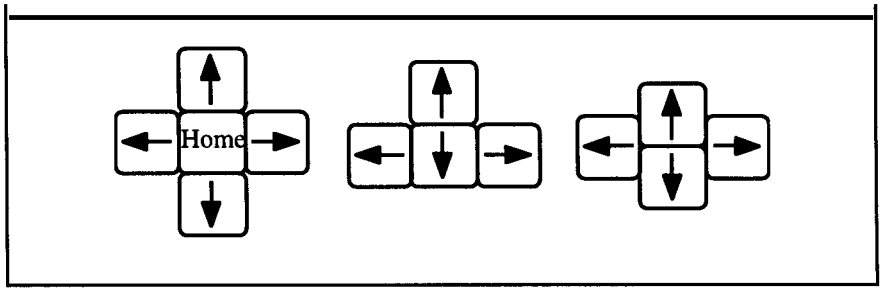
- **8.21.1.3 VDT keyboard layout and features.** VDT keyboard layout and features (such as key shape, spacing, force, and height) shall conform to ANSI/HFS 100-1988. [Source: ANSI/HFS 100-1988]

- **8.21.1.4 Standard keyboards.** If feasible, standard keyboards should be used. Nonstandard keyboards should contain only those keys that are used by the keyboard user. [Source: NUREG-0700, 6.7.1.4.i]

  Discussion. The presence of non-relevant keys, such as those that might be used by programmers, adds to keyboard complexity and may induce errors. [Source: NUREG-0700, 6.7.1.4.i]

- **8.21.1.5 Cursor movement keys.** Cursor movement keys shall be arranged in a spatial configuration reflecting the direction of actual cursor movement. Exhibit 8.21.1.5 shows the arrangement of cursor movement keys. [Source: NASA-STD-3000A, 9.3.3.4.1.1]

Exhibit 8.21.1.5 Cursor movement keys



- **8.21.1.6 Changing data.** Users shall be provided a means to change previous entries by delete, backspace, and insert actions. [Source: MIL-STD-1472F, 5.14.2.2.8]

- **8.21.1.7 Keyboard equivalents to function keys.** If an application assigns operations to function keys, the operations that can be performed with a function key should also be performable with alphanumeric keys. [Source: DISA HCISG, V1.0, 3.2]

- ▫ **8.21.1.8 Keyboard equivalents to pointing device operations.** If an application provides both a keyboard and a pointing device, the operations that can be performed with the pointing device should also be performable with the keyboard (see also paragraph 8.21.5.1). [Source: DISA HCISG, V1.0, 3.2]

8.21.2 Fixed-function keys

- ▫ **8.21.2.1 Standardization.** Fixed-function keys should be standardized throughout the system. [Source: MIL-STD-1472F, 5.14.2.3.2]

- ▫ **8.21.2.2 Availability.** Fixed-function keys should be selected to control functions that are continuously available; that is the lock out of fixed-function keys should be minimized. Mechanical overlays should not be used to lock out function keys. [Source: MIL-STD-1472F, 5.14.2.3.4]

- ▫ **8.21.2.3 Non-active keys.** When a keyboard is dedicated for use with only a specific application, blank keys on the keyboard should replace non-active fixed-function keys. [Source: MIL-STD-1472F, 5.14.2.3.5]

- ▪ **8.21.2.4 Grouping.** Fixed-function keys shall be grouped logically and shall be placed in distinctive locations. [Source: MIL-STD-1472F, 5.14.2.3.6]

8.21.3 Pointing devices

This section contains criteria and guidelines for pointing devices in general, the shape of the pointer itself, and buttons on pointing devices.

> **Definitions.** A **pointing device** is a non-keyboard device that allows a user to navigate rapidly around the screen and to specify and select objects for manipulation and action. Examples include a mouse, trackball, stylus and grid, and light pen. A **pointer** is a symbol displayed on the screen that is controlled by a pointing device. Its shape may change depending on the function that is invoked at a particular moment or its location on the screen.

8.21.3.1 General

- ▪ **8.21.3.1.1 Functionality.** When present, a pointing device shall be capable of (1) moving a pointer on the screen, (2) selecting objects on which the pointer is placed, and (3) drop and drag operations. [Source: DON UISNCCS, V1.2, 2.2.1]

- ▪ **8.21.3.1.2 Single pointer.** A pointing device shall be associated with a single pointer on the screen. [Source: DON UISNCCS, V1.2, 2.2.1]

- **8.21.3.1.3 Moving the pointer.** A user shall be able to move the pointer on the screen by moving all or part of the pointing device. The pointer shall move in the same direction that the pointing device moves. A user shall be able to move the pointer anywhere on the screen. [Source: DON UISNCCS, V1.2, 2.2.1]

- **8.21.3.1.4 Non-disappearance of pointer.** A pointer shall not move beyond the outer boundaries of the screen nor shall it disappear from sight. [Source: DON UISNCCS, V1.2, 2.2.1]

  Exception. When there is another screen adjacent to the first, the pointer may move from one screen to the other. This rule does not apply when a cursor is moved quickly and the screen refresh rate is too slow to show the full path of the cursor. [Source: DON UISNCCS, V1.2, 2.2.1]

- **8.21.3.1.5 Control of the pointer.** A pointer should not move on the screen unless a user moves the pointing device. That is, an application should not move a pointer arbitrarily. [Source: DON UISNCCS, V1.2, 2.2.1]

  Exceptions. One exception to this rule is if an application automatically moves the pointer in conjunction with the scroll bar. For example, when the user clicks on the down arrow to scroll through a document, the application may automatically move the pointer so that the pointer will remain on the scroll arrow.

  Another case may be when the pointer "jumps" or "snaps-to" a default button because the user has selected that default option. [Source: DON UISNCCS, V1.2, 2.2.1]

- **8.21.3.1.6 Pointer stability.** The stability of the pointer shall be within 1.3 mm (0.05 in) in any direction; the preferred stability is within 0.25 mm (0.01 in). [Source: DON UISNCCS, V1.2, 2.2.1]

- **8.21.3.1.7 Movement ratio.** The ratio of movement of the pointing device to the movement of the pointer should default to approximately 1:1 and be adjustable by the user. [Source: DON UISNCCS, V1.2, 2.2.1]

▫ **8.21.3.1.8 Type of device.** The pointing device selected for an application should be the one most appropriately meets the application requirements and is most cost-effective. The appropriateness of some specific types of pointing devices for tasks is as follows:

a. A **mouse** is a general purpose pointing device suitable for a wide range of applications.

b. A **joystick** is appropriate for tasks requiring precise adjustments and continuous control.

c. A **trackball** is appropriate for generating precise X and Y output values and cumulative travel in any direction.

d. A **light pen** is appropriate for non-critical, imprecise functions, especially if the primary task is item selection.

e. A **stylus and grid** is appropriate for graphic entry. [Source: MIL-STD-1472F, 5.14.2.5.1, 5.14.2.6.1; MIL-STD-1801, 4.1.5.4, 4.1.5.5, 4.1.5.7]

Discussion. Another factor that may contribute to the appropriateness of a given input device is the expectations, experiences, or preferences of the intended user population. If a given user population has a wealth of experience, familiarity, or acquired skill with a particular type of device, careful consideration needs to be given to replicate the features, functionality, performance, and "feel" to which they are accustomed. [Source: MIL-STD-1472F, 5.14.2.5.1, 5.14.2.6.1; MIL-STD-1801, 4.1.5.4, 4.1.5.5, 4.1.5.7]

8.21.3.2 Mouse

▫ **8.21.3.2.1 Use.** A mouse (also known as a free-moving X-Y controller) should be used for zero order control only (for example, the generation of X and Y outputs by the controller results in proportional displacement of the pointer). [Source: MIL-STD-1472F, 5.4.3.2.6.1]

Discussion. This type of pointing device may be used on any flat surface to generate X and Y coordinate values that control the position of the pointer on the associated display. It may be used for data pick off or for entry of coordinate values.). [Source: MIL-STD-1472F, 5.4.3.2.6.1]

- **8.21.3.2.2 Dynamic characteristics.** The design of the mouse and the placement of the maneuvering surface shall allow the user to consistently orient the mouse within 10° of the correct orientation without visual reference to the mouse. [Source: MIL-STD-1472F, 5.4.3.2.6.2]

  Discussion. If the user grasps the mouse in what seems to be the correct orientation and moves it rectilinearly along what is assumed to be straight up the Y-axis, then the direction of movement of the cursor on the CRT is to be between 350° and 10°. [Source: : MIL-STD-1472F, 5.4.3.2.6.2]

- **8.21.3.2.3 Easily moved.** The mouse shall be easy to move in any direction without a change of hand grasp. [Source: MIL-STD-1472F, 5.4.3.2.6.2]

- **8.21.3.2.4 Lateral range.** A complete lateral movement of the mouse from side to side within the maneuvering area (such as a mouse pad) shall move the pointer from side to side on the display regardless of the scale setting or offset unless expanded movement is selected for an automatic sequencing mode of operation. Users shall be able to specify or modify the lateral movement ratio. [Source: MIL-STD-1472F, 5.4.3.2.6.2]

- **8.21.3.2.5 Dimensions and shape.** The mouse shall have no sharp edges but shall be shaped roughly as a rectangular solid, with limiting dimensions as shown in Exhibit 8.21.3.2.5. [Source: MIL-STD-1472F, 5.4.3.2.6.5]

Exhibit 8.21.3.2.5 Dimensions of a mouse

Dimension	Minimum mm (in)	Maximum mm (in)
Width (spanned by thumb to finger grasp)	40 (1.6)	70 (2.8)
Length	70 (2.8)	120 (4.7)
Thickness	25 (1.0)	40 (1.6)

8.21.3.3 Joystick and trackball

Joysticks and trackballs are appropriate to use if precise input functions are required. They are most useful when used to control direct pointing, rather than discrete controls such as cursor control keys.

- **8.21.3.3.1 Use and conformity.** A joystick and trackball shall conform to sections 7.4.4.17 through 7.4.4.22. [Source: MIL-STD-1472F, 5.14.2.6.1]

- **8.21.3.3.2 Activation and deactivation.** A discrete mechanism shall be provided to allow the user to activate and deactivate the joystick or trackball. [Source: MIL-STD-1472F, 5.14.2.6.2]

8.21.3.4 Light pen

A light pen is appropriate to use if item selection is the primary type of data entry. For example, a light pen may be used when non-critical, imprecise input functions are required. It may also be used as a track-oriented readout device. It can be positioned on the display screen to detect the presence of a computer-generated track by sensing its refresh pattern. The display system will then present a cursor on the designated track. With suitable additional circuitry, a cursor can be made to track the movement of the light pen across the surface, thus allowing it to function as a two-axis controller capable of serving the same purposes as stylus and grid devices (see section 8.21.3.5).

- **8.21.3.4.1 Dynamic characteristics.** If a light pen is used as a two-axis controller, it shall conform to section 8.21.3.4. [Source: MIL-STD-1472F, 5.4.3.2.7.2]

- **8.21.3.4.2 Dimensions and mounting.** A light pen shall be between 120 and 180 mm (4.7 and 7.1 in) long with a diameter between 7 and 20 mm (0.3 and 0.8 in). A clip shall be provided to hold the light pen when it is not in use. [Source: MIL-STD-1472F, 5.4.3.2.7.3]

- **8.21.3.4.3 Activation.** A light pen shall be equipped with a discrete activating and deactivating mechanism. A push-tip switch, requiring between 0.5 to 1.4 N (2 to 4 oz) of force to activate, is preferred. [Source: MIL-STD-1472F, 5.14.2.5.3]

- **8.21.3.4.4 Feedback.** Two forms of feedback shall be provided to the user when using a light pen.

  a. Feedback concerning the position of the light pen, preferably in the form of a displayed cursor or highlighting, that informs the user that the system is recognizing the presence of the light pen. The feedback shall be large enough to be seen under the point of the light pen.

  b. Feedback that the light pen has been activated (for example, the push-tip switch has been triggered) and the input have been received by the system. [Source: MIL-STD-1472F, 5.14.2.5.4]

8.21.3.5 Stylus and grid

A stylus and grid is appropriate to use as a multipurpose input device when combined with a program for character recognition. The stylus and grid are also very good for graphic entry although they are much slower than keyboard entry for alphanumeric data.

- **8.21.3.5.1 Refresh rate.** The refresh rate for the cursor shall be sufficiently high to ensure the appearance of a continuous track whenever the stylus is used to generate free-drawn graphics. [Source: NASA-STD-3000A, 9.3.3.4.6]

- **8.21.3.5.2 Remote grid size.** A remote grid shall approximate the size of the display. [Source: NASA-STD-3000A, 9.3.3.4.6]

- **8.21.3.5.6 Remote grid placement.** A remote grid shall have an orientation that is consistent with the directional relationships between them and the display without violating any anthropometrics criteria and guidelines. [Source: NASA-STD-3000A, 9.3.3.4.6]

8.21.3.6 Pointer shapes

- **8.21.3.6.1 General-purpose pointer shape.** An arrow pointing up and to the left shall be the general-purpose pointer (↖). This and other examples of pointer shapes associated with specific functions are illustrated in Exhibit 8.21.3.6.1. If an application provides any of these functions, it shall change the pointer to the associated shape whenever that function is invoked. An application shall redefine the shape of a pointer only when the pointer is inside an application window (including the border). [Source: DON UISNCCS, V1.2, 2.2.2]

Exhibit 8.21.3.6.1 Pointer shapes associated with functions

Shape	Name	Function	Hotspot
	Arrow	**Pointing.** Used in most window areas for object selection.	The point of the arrow.
	I-beam	**Pointing.** Used in text areas to position the text cursor and perform actions on text. The I-beam pointer is hidden during the time between any keyboard action and pointer movement (that is, when text entry is occurring at the location of the text cursor).	On the vertical bar of the I-beam about one-third from the top.
	Watch (or hourglass)	**Working.** Indicates that an operation is being performed in a window area. When the working pointer is displayed, all pointing device and keyboard actions are ignored in the area.	Not applicable
	Caution sign	**Caution.** Indicates that action is expected in another window area before input can be made in the current area and that the pointer has no effect in the area. When the caution pointer is displayed, all pointing device and keyboard actions are ignored in the area.	Not applicable
	Resize pointer	**Resize.** Indicates positions for area resize, with the direction of the arrow in the pointer indicating the direction of increasing size. The horizontal and vertical resize pointers indicate resize in either the horizontal or vertical direction. The diagonal resize pointers indicate resize in both the horizontal and vertical directions simultaneously. The resize pointer appears when the pointer is on the frame border.	On the corner or line at the position pointed to by the arrow.
	Move arrows	**Moving.** Indicates a move operation in progress or a resize operation before the resize direction has been determined. During a resize operation, the four-directional arrow pointer indicates a direction for resizing and changes to the appropriate resize arrow when the pointer is on the frame border.	The intersection of the arrows.
+	Sight or cross	**Sighting.** Used to make fine position selections (for example, to select a location on a map display).	The intersection of the lines.

- **8.21.3.6.2 "Hotspot."** A pointer shall have a "hotspot," that is an active point (although this active point may not be readily apparent to the user). The hotspot shall indicate the precise location where an operation will occur. These points are specified for a variety of pointer shapes in Exhibit 8.21.3.6.1. [Source: DON UISNCCS, V1.2, 2.2.1]

  Definition. A **hotspot** is the precise part of a screen pointer that marks the screen position where an operation on a pointing device will have an effect. [Source: DON UISNCCS, V1.2, 2.2.1]

- **8.21.3.6.3 Hotspot and pointer shape.** The screen location of a hotspot shall not change if the pointer changes from one shape to another. [Source: DON UISNCCS, V1.2, 2.2.1]

- **8.21.3.6.4 Additional pointer shapes.** If an application provides a function for which a pointer shape does not exist in Exhibit 8.21.3.6.1, the application may provide a new pointer shape. If this is done, the new shape should (1) be easy to see, (2) obscure as little information as possible on the screen, (3) have a hotspot that is obvious and easy to locate, (4) provide a hint of its purpose, and (5) not be easily confused with other objects on the screen. [Source: DON UISNCCS, V1.2, 2.2.2]

8.21.3.7 Pointing device buttons

One or more buttons are provided on pointing devices to allow the manipulation of objects on the screen.

- **8.21.3.7.1 Button operations.** A user shall be able to perform the following actions with any button on a pointing device:

  a. Press. Depress a button and hold it down.

  b. Release. Release a button that has been depressed.

  c. Click. Press and release a button without moving the pointing device.

  d. Double click. Press and release a button twice in rapid succession without moving the pointing device.

  e. Drag. Depress a button and move the device while holding the button down.

  f. Move. Move the pointing device without pressing any buttons. [Source: DON UISNCCS, V1.2, 2.2.3]

- **8.21.3.7.2 Button functions.** Each button on a pointing device shall have a specific function (within the context of the application) that is executed whenever a user presses the button. If the device has only one button, that button shall provide the "select" function; if it has two buttons, the left one shall provide the "select" function and the right button shall provide a "menu" function. [Source: DON UISNCCS, V1.2, 2.2.3]

  Definitions. The **select function** selects or activates objects on the screen or sets the location of the cursor. The **menu function** causes the appearance of a menu appropriate to the location of the pointer. [Source: DON UISNCCS, V1.2, 2.2.3]

  Discussion. If applicable, a system may require that a middle button be used for a particular function (for example, as another means to execute a default action). An application can map a function to the middle button if the function does not contradict or interfere with the function assigned to this button by the system or by another application. [Source: DON UISNCCS, V1.2, 2.2.3]

- **8.21.3.7.3 Left-right reversal.** A system shall provide users the ability to reverse the left-right operation of the buttons. [Source: DON UISNCCS, V1.2, 2.2.3]

8.21.4 Alternative input devices (non-keyboard, non-pointing devices)

Application developers are encouraged to use input devices in unique ways to support efficient user performance within an application. In addition, developers might determine that devices such as voice input or touch panels are appropriate alternatives for user input.

8.21.4.1 General

- ▫ **8.21.4.1.1 Consistent interaction.** If an alternate input device is used in an application, the manner in which users interact with the device (e.g., for navigation or selection) should be consistent with their interactions with other input devices. [Source: DON UISNCCS, V1.2, 2.4]

- ▪ **8.21.4.1.2 Type of device.** The alternate input device selected for an application shall be the one that most appropriately meets the application requirements and is most cost-effective. The appropriateness of some specific types of input devices for tasks is as follows:

  a. A **touch screen or touch panel** is appropriate for data entry and item selection if typing skills are not required.

  b. An **optical character recognition device** is appropriate for the entry of formatted, printed data.

  c. A **voice input** device is appropriate if the user's visual and manual performances are constrained. [Source: MIL-STD-1801, 4.1.5.8, 4.1.5.9, 4.1.5.10]

8.21.4.2 Touch panels

- ▫ **8.21.4.2.1 Use.** A touch panel or screen should be used to provide an overlaying control function to a display device (e.g., a CRT, an electro luminescent display, or a programmable indicator) if direct visual reference access and optimum direct control access are desired. [Source: MIL-STD-1472F, 5.4.6.1]

- ▫ **8.21.4.2.2 When not to use.** A touch panel or screen should not be used if the user will be making large amounts of data input. [Source: NUREG- 0700, Vol.2 - 3.2.4-1]

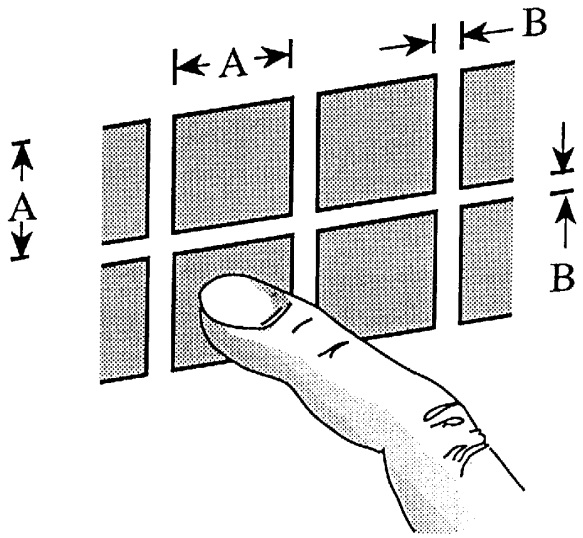
- ▪ **8.21.4.2.3 Luminance transmission.** Touch panels shall have sufficient luminance transmission to allow the display to be clearly readable in the intended environment. [Source: MIL-STD-1472F, 5.4.6.2]

- ▪ **8.21.4.2.4 Positive indication.** A positive indication of touch-panel activation shall be provided to acknowledge the system response to the control action. [Source: MIL-STD-1472F, 5.4.6.3]

- **8.21.4.2.5 Dimensions and separation.** The dimensions and separation of responsive areas of the touch panel shall not exceed the maximum and minimum values given in Exhibit 8.21.4.2.5. [Source: MIL-STD-1472F, 5.4.3.1.5.1]

  Note. The maximum values listed in the exhibit apply to logically grouped touch panel responsive areas. An adverse environment may warrant larger sizes and separations.

Exhibit 8.21.4.2.5 Touch panel responsive area dimensions



	A Size	B Separation
Minimum	19 mm (0.75 in)	3 mm (0.13 in)
Maximum	38 mm (1.5 in)	6 mm (0.25 in)

- **8.21.4.2.6 Resistance.** The force required operating force-activated touch panels shall conform to ANSI/HFS 100-1988. [Source: DOE-STAND HFAC 1, 5.4.5.5]

- **8.21.4.2.7 Display feedback.** Display of user command or action feedback for touch panels shall not exceed 0.25 seconds. [Source: MIL-STD-1472F, 5.4.6.4]

8.21.4.3 Voice control

- **8.21.4.3.1 Phonetically distinct vocabulary.** Testing should be performed to determine which sounds and words or phrases used in spoken entry transactions are phonetically distinct from one another. [Source: Smith & Mosier, 1986 –1.34]

  Discussion. Spoken command entries are not to be chosen arbitrarily. Tradeoffs between phonetic distinctiveness and familiarity of terminology need to be evaluated. Because the same spoken entry may be received differently by different systems. of this, spoken entries may not be chosen based on their use with other systems. [Source: Smith & Mosier, 1986 –1.0/34]

- **8.21.4.3.2 Easy error correction.** Feedback and simple error correction procedures shall be provided for speech input so that if the computer has not correctly recognized a spoken entry, the user can easily cancel the entry and try again. [Source: Smith & Mosier, 1986 –1.0/35]

- **8.21.4.3.3 Alternative entries.** Alternative input devices shall be available so that if the system cannot recognize a voice entry after repeated attempts, another type of input entry can be substituted. [Source: Smith & Mosier, 1986 – 1.0/36]

8.21.5 Interchangeability among input devices

The interchangeability among input devices by the user can be useful during specific operations. Users may want to perform some actions using a keyboard and others actions using a pointing device. The ability to choose which input device must be optional to the user and not a requirement by the system.

- **8.21.5.1 Redundant control.** If more than one input device is present, a user should be able to control computer interaction with all of them. For example, a keyboard should be capable of executing navigation and selection operations when used in conjunction with a mouse, light pen, or other input devices (see also 8.21.1.8). [Source: DON UISNCCS, V1.2, 2.1]

  Discussion. Full interchangeability is not required. It is assumed that a user will select the input device that is most appropriate for the task being performed. For example, a user may rely on direct manipulation, using a pointing device such as a mouse or trackball, as the primary means of interaction for object selection and manipulation. Similarly, a user may use a keyboard primarily for text entry and for object selection being performed in conjunction with or interspersed with text entry. [Source: DON UISNCCS, V1.2, 2.1]

8.21.6 Input devices to accommodate people with disabilities

8.21.6.1 Accommodating people with moderate physical disabilities

Most of the difficulty experienced by people with physical disabilities in using computer systems stem from using input devices, such as a keyboard or a mouse, and from handling storage media, such as computer diskettes.

- **8.21.6.1.1 "Pointing" from the keyboard.** A system that uses a pointing device, such as a mouse, should include a means for carrying out all of the pointing functions from the keyboard. [Source: Scadden & Vanderheiden, 1988, P-3, p. 16]

- **8.21.6.1.2 Cursor control devices.** The select key on a cursor control device should have toggle capabilities, either as a standard feature or as a user-configured option, that allow a user to operate the device in a "button down" mode. [Source: Casali, Proc. of the HFS, 36, 311-315]

  Discussion. People with disabilities may have difficulty simultaneously holding a select button down and moving the device, for example, in "dragging" an object in a graphical display. [Source: Casali, Proc. of the HFS, 36, 311-315]

- **8. 21.6.1.3 Avoiding inadvertent operation.** A computer or computer system intended to be operable by people with moderate motor disabilities should provide either a means for delaying the acceptance of a keystroke for a preset, adjustable amount of time or a keyguard or means for mounting a keyguard. [Source: Scadden & Vanderheiden, 1988, P-6, pp. 21-22]

  Definition. A **keyguard** is a keyboard cover with holes over keys the user is allowed to operate. [Source: Scadden & Vanderheiden, 1988, P-6, pp. 21-22]

- **8.21.6.1.4 Keyguards.** Keyboards should be designed so that keyguards can be mounted easily. [Source: Scadden & Vanderheiden, 1988, M-6, p. 53]

  Discussion. It is desirable that the manufacturers of the keyboard also supply a compatible keyguard. [Source: Scadden & Vanderheiden, 1988, M-6, p. 53]

8.21.6.2 Accommodating people with severe physical disabilities

For people with severe physical disabilities, modifications to standard input devices may not be sufficient to allow them to use a computer. In these cases, a means for connecting an alternative keyboard, mouse, or other input device may be required. [Source: Scadden & Vanderheiden, 1988, p.23]

- **8.21.6.2.1 Connection point for alternative input device.** A computer or computer system should provide a point at which an alternative input device can be connected. [Source: Scadden & Vanderheiden, 1988, SP-1, pp. 24-25]

- **8.21.6.2.2 Input from alternative device.** The computer should treat input from the alternative device the same as input from standard input devices. [Source: Scadden & Vanderheiden, 1988, SP-1, pp. 24-25]

  Discussion. One possible solution would be to provide a system command that would cause input from a standard serial, parallel, or other system port to be treated as if it had come from the computer's standard input devices. [Source: Scadden & Vanderheiden, 1988, SP-1, pp. 24-25]

8.21.6.3 Accommodating people with visual disabilities

- **8.21.6.3.1 Readability of lettering on keys and controls.** The lettering on keys and controls required for the operation of a computer or computer system should be large enough to be read easily and have a distinct contrast with its background. [Source: Scadden & Vanderheiden, 1988, V-3, p. 30]

  Discussion. This might be accomplished by providing keycaps that can be removed easily and replaced with special keycaps for the visually impaired. [Source: Scadden & Vanderheiden, 1988, V-3, p. 30]

- **8.21.6.3.2 Connection point for alternative output devices.** Computers and computer systems should provide a point to which an alternative output device can be connected. [Source: Scadden & Vanderheiden, 1988, B-1, pp. 32-33]

  Discussion. The connection point might be a standard serial or parallel port. Alternative output devices include speech synthesizers and Braille display devices. [Source: Scadden & Vanderheiden, 1988, B-1, pp. 32-33]

- **8.21.6.3.3 Alternatives to input devices.** When a computer or computer system has a standard input system that requires continuous visual feedback for operation, (e.g., a mouse or touch screen), an alternate means or mode for achieving as many of the input functions as possible should be provided. [Source: Scadden & Vanderheiden, 1988, B-2, p. 34]

  Discussion. It may not be possible to provide a reasonable alternative for some functions. For example, inputs such as free hand sketching cannot be done easily without a device that requires eye-hand coordination. [Source: Scadden & Vanderheiden, 1988, B-2, p. 34]

- **8.21.6.3.4 Availability of alternatives.** Alternative means or mode for input should be available at all times and should not require continuous visual feedback. [Source: Scadden & Vanderheiden, 1988, B-2, p. 34]

- **8.21.6.3.5 Non-visual indication of state of toggle keys.** A computer or computer system should provide blind users with a non-visual indication of the state of toggle keys that is available automatically or upon the user's request. [Source: Scadden & Vanderheiden, 1988, B-3, pp. 35-36]

- **8.21.6.3.6 Key demarcation.** All keys should have edges that can be discerned by touch. [Source: Scadden & Vanderheiden, 1988, B-4, pp. 37-38]

  Discussion. In particular, flat membrane keys without ridges outlining the keys are particularly difficult. [Source: Scadden & Vanderheiden, 1988, B-4, pp. 37-38]

- **8.21.6.3.7 Identification of "home" keys.** The "home" keys of keyboards and keypads should have a distinct marking that can be discerned by touch. [Source: Scadden & Vanderheiden, 1988, B-4, pp. 37-38]

- **8.21.6.3.8 Key labels.** Optional or built-in non-visual labeling of keys should be provided or available. [Source: Scadden & Vanderheiden, 1988, B-4, pp. 37-38]

8.21.6.4 Accommodating assistive devices

- **8.21.6.4.1 Electronic documentation.** Manuals and other important documentation intended to be accessible to people with disabilities should be available in electronic as well as printed form. [Source: Scadden & Vanderheiden, 1988, M-1, p. 48]

  Discussion. This would permit presentation of the material on an assistive device such as an enlarged display, a speech synthesizer, or a Braille reader. [Source: Scadden & Vanderheiden, 1988, M-1, p. 48]

- **8.21.6.4.2 Speech output compatibility.** Computers and computer systems should provide a built-in speech output capability or provide a point to which a speech synthesizer can be connected. [Source: Scadden & Vanderheiden, 1988, M-2, p. 49]

- **8.21.6.4.3 Special display window.** A windowing environment should provide the capability of opening and maintaining a special window that can remain fully visible and available continuously for use by special input routines. [Source: Scadden & Vanderheiden, 1988, M-3, p. 50]

- **8.21.6.4.4 Connection point for switches.** Computers and computing systems should provide a point at which at least two momentary contact single-pole single-throw input switches can be connected. [Source: Scadden & Vanderheiden, 1988, M-4, p. 51]

  Discussion. Some alternative input devices require the connection of special switches or interfaces. Examples are "sip and puff" switches and eye blink switches. Unused pins on existing connectors could serve as these connection points. It would be desirable to be able to connect analog transducers as well as binary switches. [Source: Scadden & vanderheiden, 1988, M-4, p. 51]

- **8.21.6.4.5 Distinguishing macro input from typed input.** Computers and computing systems should be able to distinguish between typed, auto-repeat, and macro-generated "keystrokes" so that they can be treated differently by the operating systems and application software. [Source: Scadden & Vanderheiden, 1988, M-5, p. 52]

  Discussion. "Keystrokes" generated by assistive devices or assistive software may be sent faster than the application software can recognize them, in which case, they may be ignored, thus preventing use of the assistive device or software. [Source: Scadden & Vanderheiden, 1988, M-5, p. 52]

GLOSSARY

Abbreviation - any shortened form or abridgment of a word, expression, or phrase used to conserve space or time including initializations, contractions and acronyms.

Accelerators - keyboard commands that can be used instead of pointing and clicking on menu options. They are indicated by underlining the proper character and placing the keyboard alternative in parenthesis after the option (e.g., Bold (Ctrl+B).

Active Help – a form of Help that senses an inappropriate entry and interrupts the task to ask users what they are attempting and if they are sure they want to complete the operation they have just initiated. Depending upon the user response to the question, active Help then suggests the correct action.

Advice - an interactive, context-sensitive Help source that indicates what entry to make at the current location in the application, the required keystroke(s), or which steps to take to complete the task.

Advisory - a signal that indicates a safe or normal configuration, condition of performance, or operation of essential equipment or attracts attention and imparts information for routine action purposes.

Alert - a signal that indicates a condition relating to the effective performance of duties. The condition or message requires the operator or maintainer to take immediate action or indicates that a significant update in information necessary for the effective performance of duties is available.

Attributes - instructions that change the characteristics of a selected item. An example of an attribute is changing text from standard to bold type.

Cascading menu - a type of hierarchical menu in which a submenu is attached to the right side of a menu item. Cascading menus can be added to drop-down menus, pop-up menus, or even other cascading menus.

Caution - a signal that indicates the existence of a condition requiring immediate attention but not immediate action.

Client area (or working area) - the main area of the window that users employ to do their operational or application tasks. It is the area where users make their inputs and receive their outputs.

Combo box - a special type of text box with an attached list of options. Combo boxes allow the user to either select from the given list or type in an alternative response. There are two types of combo boxes, standard and drop-down.

Commands - instructions that cause a device to perform some action.

Command entries - a type of control entry that enables the user to initiate a message to the system that will specify desired functions.

Command language - a limited programming language used strictly for executing a series of commands (e.g., Linux, any DOS shells).

Contrast - the difference in luminance of two areas often expressed in terms of a contrast ratio.

Contrast ratio - the luminance level of the foreground divided by the luminance level of the background.

Control entries - user input for sequence control, such as function key activation, menu selection, and command entry.

Cursor - a marker on the display screen that indicates the position where the computer expects the next input or will display the next output. The cursor may be positioned by the computer or by the user.

Database - a set of interrelated data stored in a computer.

Data-entry window - a window that contains a set of labeled fields for entering, changing, and deleting data. It may also contain labeled data display fields, which a user cannot change.

Direct manipulation dialog – when the user controls the interface with the computer by acting directly on objects on the display screen. An object may be an icon, menu option, symbol, button, or dialog box.

Disability - a physical or mental impairment that substantially limits one or more of a person's major life activities.

Display sequencing - a means of reducing clutter by displaying a series of partial displays (e.g., a map and a series of overlays) or of displaying data sequentially. It can also be used as a form of animation.

Drop-down combo box – a combo box that has a down arrow button, and a drop-down list.

Ellipses - visual indicators, such as three dots (...), used to make menu options that branch to other sub-menus distinguishable from menu options that will immediately perform an operation.

Exclusive buttons (option buttons or radio buttons) - single, two-state choices, which are mutually exclusive from each other.

Function keys - labeled keys that serve as keyboard short cuts (e.g., F1, F2, F3, or with the function name such as Delete or Insert) by combining in one key the actions of a sequence of individual keys.

Graphic menus (palettes) - a set of unlabeled symbols, typically presented within small rectangles. Symbols may be icons, patterns, characters, or drawings that represent an operation. Palettes are used widely in drawing and painting packages but are commonly found in word-processing applications as well.

Grid lines - horizontal lines, vertical lines, or both extending from the scale divisions of one or both axes of a graph and intended to aid users in locating and reading data points.

Group - on a pull-down menu is any set of menu items between two separators or the whole list if there are no separators on the pull-down menu.

Hierarchical menu - a large series of options or menus that is organized as a multi-level, branching structure in which an option in a higher-level menu is the name of another menu at the next lower level. The options in the lowest level menus are not the names of other menus. They are commands or selectable values such as color squares on a palette or specific Auto Text choices (e.g., Dear Sir, or To Whom It May Concern)

Hot spot - the selectable area in which a user can place the pointer and successfully select an icon.

Impairment - a loss or abnormality of physiological or anatomical structure or function.

Input focus - the notion that only one window and usually only one object in a window at a time is capable of accepting input from a pointing device or the keyboard.

Keyboard accelerator - a key or simultaneous combination of keys that a user can type to select an option in a menu without having to display the menu.

Keyboard lockout - a state determined by an application in which the application does not accept input from the keyboard.

Keyguard - a keyboard cover with holes over keys the user is allowed to operate.

Menu - a list of options from which a user makes a selection or selections.

Menu bar - a narrow panel, usually at the top of a computer screen in menu-based computer systems, that continually displays the highest-level menu options for selection by the user. The options on a menu bar are usually the names of other menus.

Menu function - causes the appearance of a menu appropriate to the location of the pointer.

Message window (**message box**) - a secondary window that provides users with non-critical information, progress information about lengthy processes, alerts to unusual events, and/or warnings of potential dangers. Message windows may be modal or modeless.

Minimize – the operation that reduces a windows presence into a standby icon button on the information line at the bottom of the screen.

Mnemonic - a single letter that a user can type to select an option in a menu.

Modal window - a window with which a user must interact before being able to interact with any other windows. A user cannot interact with other windows as long as the modal window is displayed.

Modeless window - a window that allows a user to interact with other windows.

Navigation keys - several keys such as **Home, End, Page Up, Page Down**, and the arrow keys, which are dedicated to keyboard navigation.

On-line Help - primarily an interactive, context-sensitive source of information that can prompt a user what entry to make at the current location in an application, what keystrokes are required, or what steps are required to complete a task. Secondarily, on-line Help is a form of on-line documentation and reference information.

Option - one of the selectable items in a menu.

Option buttons (exclusive buttons or radio buttons) - single, two-state choices, which are mutually exclusive from each other.

Outline selection - an extended form of drag selection that is particularly useful for graphical objects when normal drag selection conflicts with moving objects with the mouse.

Paging - the process of scrolling through data one page at a time.

Palettes (graphic menus) - a set of unlabeled symbols, typically presented within small rectangles. Symbols may be icons, patterns, characters, or drawings that represent an operation. Palettes are used widely in drawing and painting packages but are commonly found in word-processing applications as well.

Panes - the separate viewing areas in a split window.

Panning - an orientation of display framing in which a user conceives of the display frame as moving over a fixed array of data.

Passive Help – a form of Help that simply responds to user requests for information. The information may be in the form of on-line system documentation, such as a user's guide or a list of functions performed by combinations of key presses.

Pointer - a symbol displayed on the screen that is controlled by a pointing device. Its shape may change depending on the function that is invoked at a particular moment or its location on the screen.

Pointing device - a non-keyboard device that allows a user to navigate rapidly around the screen and to specify and select objects for manipulation and action.

Pop-up menus - menus that only appear on user demand. They are often associated with a particular object on a display, (e.g., a pop-up menu listing acceptable command options close to the immediate work area). Because pop-up menus are not displayed all of the time, they do not take up valuable screen space. They provide an efficient way to access commands because they eliminate the need for the user to navigate to a menu bar or control bar. A pop-up menu typically contains 5 to 10 options presented in a vertical listing.

Primary window - a top or high-level window in an application. It is the main location of user interaction and functions independent of other primary windows in the application.

Pull-down menu - a menu associated with an option on a menu bar that appears when a menu bar option is selected.

Query - the process of specifying, locating, and retrieving data matching specified characteristics from a database.

Radio buttons (exclusive buttons or option buttons) - single, two-state choices, which are mutually exclusive from each other.

Reasonable accommodation - any modification or adjustment to a job or the work environment that will enable a qualified person with a disability to participate in the application process and to perform essential job functions.

Saturation - the relative amount of whiteness in a chromatic color.

Scrolling - a method used to move through the contents of a window or list in a dialogue box using the scroll-bar or scroll arrows.

Scrolling menu - a menu usually containing many options that does not display all of the options at once. It includes a scroll-bar that permits the sequential display of all options. Scrolling menus are also called list boxes and scrolling lists.

Secondary window - a window that is displayed from within a primary window or another secondary window. Secondary windows are sometimes called child windows.

Select function - selects or activates objects on the screen or sets the location of the cursor.

Selection - the action a user makes in choosing a menu option. Selection may be accomplished by pointing, by typing, or by pressing a function key.

Slider - a control used to set a value and give a visual indication of the setting.

Soft function key - an area on the screen that represents a function key.

Speech interference level - a measure of the effectiveness of noise in masking speech. It is the arithmetic mean of the same pressure levels of interfering noise (in dB re 20☞ Pa) in the four octave bands centered on the frequencies 500, 1000, 2000, and 4000 Hz, respectively. The unit of speech interference is the decibel (dB).

Spin button (also known as a **spin box**) - a variation of the scrolling menu or list. A spin button is made up of a text box and two arrows and displays a sequence of mutually exclusive choices.

Spin box (also known as a **spin button**) - a variation of the scrolling menu or list. A spin box is made up of a text box and two arrows and displays a sequence of mutually exclusive choices.

Split bar - the divider placed across the middle of the window that separates the panes.

Split box - a rectangular indicator located inside the scroll-bar of a split window or immediately above the scroll-bar of a split-able window. Note, however, that in some guidelines, the split box is called the split bar.

Stacking - the stringing together of commands so that they can all be executed with a single command.

Standard combo boxes - a special type of text box that includes a standard list of options with all options visible to the user.

Status bar - a special type of message bar used to present information about the current status of the application.

Syntax - the set of rules governing the language of a command language. Examples would be rules about the order in which parts of a command occur or rules about punctuation in commands

Tear-off menu - a menu that can be removed from the menu bar and moved to another location on the screen where it can remain on display. Tear-off menus are also called "tacked" or "pushpin" menus.

Text boxes - edit controls into which the user types information. Most text boxes are one line tall, but applications can also use multi-line text boxes.

Text frame - a sizable field into which the user can type text. This is a dynamic form of an edit field and should not be confused with the text box. Although text frames are generally rectangular, other shapes may also be used.

Toggled menu options – options that are used to issue commands as a binary selection of one of two opposite commands.

Tonal coding - coding based on different shades of the same hue or different patterns or textures.

Utility window - a supplementary window that provides the users with additional tools or controls such as a tool palette or a set of text attributes.

Warning - a signal that indicates the existence of a hazardous condition requiring immediate action to prevent loss of life, equipment damage, or a service interruption.

Working area (or client area) - the main area of the window that users employ to do their operational or application tasks. It is the area where users make their inputs and receive their outputs.

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