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Electronic Display of Aeronautical Information
(Charts)

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1. SCOPE:

The objective of this ARP is to provide a set of user-centered design guidelines for the implementation of data driven electronic aeronautical charts, which dynamically create charts from a database of individual elements. The data driven chart is intended to provide information required to navigate, but it is not intended to supplant the aircraft's primary navigation display. These guidelines seek to provide a balance between standardization of equipment with similar intended functions and individual manufacturer innovation.

This ARP provides guidelines for the display of an electronic chart that can replace existing paper. This document addresses what information is required, when it is required, and how it should be displayed and controlled. This document does not include all the detailed specifications required to generate an electronic aeronautical chart. This document primarily addresses the human factors aspects of electronic chart display, and does not address the software, hardware or system integrity/availability issues associated with certification of an electronic chart system.

During the transition to data driven charts, the guidelines of this document should be applied to interim electronic chart products that may be pre-composed, such as vector or raster based electronic charts.

This document is designed primarily for IFR Aeronautical Charts. There is a limited discussion of its applicability to VFR charts.

1.1   Background:

Navigation charts have historically been produced as paper products and carried by the flight crew from aircraft to aircraft, providing standardization from one aircraft type to another. Early versions of electronic charts have essentially been electronic representations of the paper products and because each operator still tends to use a single supplier, standardization is still provided. It is also vitally important to maintain consistency among database-driven electronic aeronautical charts.

As electronic charts move toward becoming more integrated into individual flight decks, the design may become subject to the divergent philosophies of individual manufacturers. In the past, this has resulted in diverse implementations of Electronic Flight Instrument Systems and Flight Management Systems. This document provides a set of guidelines to promote an appropriate level of consistency among manufacturers.

1.2   Relation of Electronic to Paper Aeronautical Charts:

The current paper chart products have a long history in the aviation community and have evolved gradually to their current state. Since paper charts and electronic charts will both be used during the transition, it is important that mixed usage does not cause operational conflicts. Therefore, electronic charts should draw on the lessons learned in the development and use of paper charts. Electronic charts should be displayed in a manner that makes their use compatible with paper charts while taking advantage of the capabilities of electronic displays. These advantages include clutter reduction, phase of flight configuration, aircraft position overlay, zoom in/zoom out and layering of other useful information (e.g., weather radar and other graphically depicted information). Electronic databases can be rapidly and reliably updated using datalink technology.

1.3   Overview:

Section 2 - REFERENCES: This contains a list of documents that are applicable to the implementation of these guidelines and other reference publications.

Section 3 - DESIGN PHILOSOPHY: This section describes the user centered design philosophies used in developing the design guidelines contained in Section 4.

Section 4 - DESIGN GUIDELINES: This section describes information requirements (temporal and content). It also outlines general rules governing information display and control to achieve an acceptable level of standardization throughout the industry.

Section 4.1 - Aeronautical Information Display Elements: An electronic aeronautical chart as described in this document is made up of a set of individual display elements, assumed to be contained in a unique chart file.

Section 4.2 - Phase of Flight: defines the phases of flight and their relationship to selected procedures.

Section 4.3 - Display Standards: Provides guidance on information grouping, location and display formats to create a standardized look between displays without unduly restricting individual manufacturers' innovation.

Section 4.4 - Control Standards: Describes the minimum level of standardization required to achieve a similarity in control between different implementations. This section does not deal with hardware features.

Section 4.5 - Chart System: References established guidelines such as those in FAA Advisory Circular 120-76A, for guidance on hardware and software issues.

Section 4.6 - Notice to Airmen: Provides information on issues concerning NOTAM applicability and display as it pertains to electronic chart information and its display.

1.3   (Continued):

Section 5 - CHART GENERATION COMPONENTS: This section describes key components of the overall chart generation process.

Section 5.1 - Common Database: There may be numerous databases that contain all the detail information common to all electronic charts.

Section 5.2 - Chart File: A unique chart file will define each charted procedure. The chart file in its simplest form is a listing of every display element that comprises an individual electronic chart and the various attributes and rules unique to the chart.

Section 5.3 - Display Generation: The display system uses the information in the chart file to render the electronic chart per the guidelines in this document.

Section 5.4 - Charting Specifications: An electronic chart should comply as closely as possible with existing paper aeronautical charting specifications modified to take advantage of the electronic display medium.

Section 6 - NOTES: Document administrative notes.

Appendix A - Abbreviations and Acronyms

Appendix B - Glossary

Appendix C - Electronic Chart Display Group Locations: Provides background on how the group location guidelines of this document were developed.

Appendix D - Provides background and Aeronautical Information Criticality Matrices: descriptive information on the criticality matrices. Also includes the detail matrices for each chart type.

Appendix E - Chart Decluttering Examples: Provides examples of how the decluttering guidelines of this document may be used.

2. REFERENCES:

2.1 Applicable Documents:

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

ARP5289   Electronic Aeronautical Symbols

2.1.2 FAA Publications: Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591.

FAA AC 120-76A   Guidelines for the Certification, Airworthiness, and Operational Approval of Electronic Flight Bag Computing Devices

2.1.3 ICAO Publications: Available from Document Sales Unit, International Civil Aviation Organization (ICAO), 999 University Street, Montreal, Quebec, Canada H3C 5H7.

ICAO Annex 4   Aeronautical Charts

ICAO Annex 15   Aeronautical Information Services

2.1.4 RTCA Publications: Available from RTCA Inc., 1140 Connecticut Avenue, NW, Suite 1020, Washington, DC 20036.

RTCA DO-257A   Minimum Operational Performance Standards for the Depiction of Navigation Information on Electronic Maps

2.2   Related Publications:

The following publications are provided for information purposes only and are not a required part of this document.

2.2.1   SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

ARP1874   Design objectives for CRT Displays for Part 25 Aircraft

ARP4032A   Human Engineering Considerations in the Application of Color to Electronic Aircraft Displays

ARP4102   Flight Deck Panels Controls and Displays

ARP4102-7   Electronic Displays

ARP4256   Design Objectives for Liquid Crystal Displays for Part 25 (Transport) Aircraft

ARP5364   Human Factor Considerations in the Design of Multifunction Display Systems for Civil Aircraft

ARP5898   Human Interface Criteria for Flight Deck Surface Operations Displays

Paper 975555   Elfriede F. Hofer

2.2.2   FAA Publications: Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591.

FAA AC 61-27C   Instrument Flying Handbook

2.2.3   RTCA Publications: Available from RTCA Inc., 1140 Connecticut Avenue, NW, Suite 1020, Washington, DC 20036.

RTCA DO-267A   Minimum Aviation System Performance Standards (MASPS) for Flight Information Services Broadcast (FIS-B) Data Link

RTCA DO-289   Minimum Aviation System Performance Standards (MASPS) for Aircraft Surveillance Applications

RTCA DO-272   User Requirements for Aerodrome Mapping Information

RTCA DO-276   User Requirements for Terrain and Obstacle Data

2.2.4   NASA Publications: Available from NASA, Documentation, Marshall Space Flight Center, AL 35812.

NASA Technical Paper 3561 - Wendell Ricks

2.2.5   VOLPE Publications: Volpe documents are available to the public through the National Technical Information Service, Springfield, VA 22161.

DOT-VNTSC-FAA-95-9   Research Document for the Design of Electronic Instrument Approach Procedure Displays

2.3   Definitions:

2.3.1   Terms: Definitions for the various terms used in this document may be found in the Glossary in Appendix B.

2.3.2   Acronyms and Abbreviations: Definitions for the various acronyms and abbreviations used in this document may be found in the Appendix A.

3.   DESIGN PHILOSOPHY:

This section describes the underlying philosophies that are used to establish the design guidelines in Section 4. These philosophies are based on generally accepted design criteria that apply to the task of designing electronic chart displays.

The electronic display of aeronautical information must support the needs of the flight crew. Display design must take into account pilot requirements in differing phases of flight, which includes both the planning function and the use of the display in executing procedures.

3.1   Workload/Simplicity:

- The electronic display should limit the number of features and operating modes as much as possible and yet provide the proper flexibility to accommodate the needs of the pilot.

- Accessing information on an electronic aeronautical chart should be quicker and easier than using a conventional paper chart.

3.2   Grouping of Information:

- Information should be organized into meaningful groups of related information. These groupings will assist the flight crew in developing an efficient framework for working with the system. Maintaining these consistent groups across all implementations will enhance the ability to transition from one system to another.

3.3   Consistent Placement of Information:

- Information should be able to be placed in the same location as much as possible. This applies to the placement of individual pieces of information, as well as the placement of information groups. Information groups should be placed consistently from one implementation to another, further enhancing the ability to transition from one to another.

3.4   Clutter:

- The information that is required for a particular procedure must be readily available and presented in a legible and useable fashion on an electronic chart. Electronic charts offer clutter reduction capabilities not available to paper charts. Display limitations may require specific clutter reduction algorithms to remain legible and useable.

3.5   Tie to Paper Charts:

- When developing the electronic display of aeronautical information, the experience learned from using paper charts must be considered. Where differences in presentation do occur, pilots should be able to correlate those differences with a minimum amount of re-training.

3.6   Automation:

- Any task that is automated must be able to be overridden by the flight crew. Automation must always be subservient to the flight crew.

- The implementation of automation should attempt to reduce crew workload. The automated functions should be tested to ensure that it does not increase workload during those phases of flight when crew workload is highest.

- If possible, situational factors, such as phase of flight, should be accounted for automatically.

- The design should facilitate the communication of tasks from one system to another to avoid duplication of activities for the flight crew. For example, when the flight crew has programmed a flight plan into the aircraft's navigation system, the system, if possible, should communicate this information to the electronic aeronautical chart system to facilitate correct chart selection.

3.7   Information Access:

- Critical information and specific crew information requirements must be quickly accessible.

- Information that has been deselected automatically must be reselectable for display by the flight crew.

- To accommodate unanticipated events, requirements, and usage, charting information should never be restricted for selection by the flight crew.

- To assist the flight crew in locating important information quickly, items should be formatted to stand out from other similar information. This may be done by placing it at the top of a prioritized list, or by highlighting it in some manner.

- Different strategies may need to be provided for flight crew access to information on an electronic aeronautical chart to accommodate different operational situations.

3.8   Forgiveness:

- The system should be tolerant of flight crew input errors.

- The design should allow for a simple method to revert to default information when the flight crew has customized the display.

- A means should be provided to cancel an action.

- A means may be provided to undo actions to return to previous or initial states.

3.9   Modes:

- The use of modes should be limited to as few as possible to support the display and control strategies necessary to quickly and reliably access information.

- If different modes are available, it must be made clear to the flight crew which is the current operating mode.

- Operational features should be consistent across different modes.

4. DESIGN GUIDELINES:

This section provides guidelines for determining the information display and control requirements based on the design philosophies outlined in Section 3. The guidelines are not meant to be used as strict design specifications. The intent is to provide a set of guidelines which when followed, will result in an appropriate level of standardization throughout the industry.

4.1 Aeronautical Information Display Elements:

Each electronic aeronautical chart consists of a set of display elements, which are assumed to be contained in a unique chart file as described in 5.2. To render and display an electronic chart as described in this document, each element will have an associated set of attributes as described below.

4.1.1 Generic Display Element Attributes: Each element has a set of consistent attributes that may be contained in a database or library separate from the specific chart file. Examples of generic attributes include:

- Latitude and Longitude of an Element.

- Element Type (e.g., obstacle)

- Element Graphic Symbol

4.1.2 Chart Specific Display Element Attributes: For any given electronic chart, an element may have a set of attributes that are specific to that chart. These attributes are the key to allowing a data driven electronic chart to fully leverage display capabilities. A set of chart specific attributes is described below.

4.1.2.1 Route Applicability: An electronic chart file may contain information for procedures that have multiple routing options. Each display element should be associated with all applicable routes.

4.1.2.2 Equipage: Each electronic chart file will typically contain information for varied equipage. An attribute may indicate that an element only applies to certain equipment (e.g., VOR, FMS, CAT II).

4.1.2.3 Criticality: The term criticality indicates the importance of a given display element with respect to aircraft operation when using an electronic chart. The level of criticality is based on functional importance and not frequency of use. Based on an analysis of each chart type throughout the total flight regime (taxi, takeoff, climb, etc.), changes in criticality may occur between the following two functions:

- When an electronic chart is being used to brief a procedure.

- When the electronic chart is being used to execute a procedure.

The assessment of criticality for each display element is based on a three-level rating scale as described below.

4.1.2.3.1 Level 1: Level one items are required display elements that generally cannot be removed from the electronic chart display. Level one items have the following characteristics:

- Any item that is required to maintain the aircraft on the procedure or defined route (both horizontal and vertical) and provide information for planning an appropriate number of future legs.

- Any item required for identifying navigation fixes used on the instrument procedure. This applies to fixes on the current leg and an appropriate number of future legs.

- Items that are required to insure proper identification of the landing airport, procedure, and runway.

- Any item that has been shown to be critical to safety of flight. This can be either by analysis or based upon historical precedence.

- Any item the chart designer/database supplier determines should not be removed from the electronic chart display.

4.1.2.3.2   Level 2: Level two items should initially be presented, but may subsequently be deselected and reselected by flight crew action. Level two items have the following characteristics:

- Communications information pertinent to the active and appropriate number of future legs.

- Items that provide situational awareness with respect to objects that the aircraft could collide with in the event of navigational error (e.g., terrain or obstacles).

- Items that alert the crew to a potential hazard (e.g., special use airspace is a level 2 in SIDs, STARs and Approaches).

- Items that alert the flight crew to operations that require heightened crew awareness (e.g., simultaneous parallel approaches, Land and hold Short Operations on an intersecting runway).

4.1.2.3.3   Level 3: Level three items do not need to be initially presented. Level 3 items may be selected/deselected by the flight crew. In addition, these items may be automatically removed from the display by the electronic chart system display algorithms. Level 3 items have the following characteristics:

- Supplemental information the chart designer/database supplier has determined can improve operational efficiency.

- Information that has already been viewed but is no longer required when using the chart.

4.1.2.3.4   Aeronautical Information Matrices: A set of Aeronautical Information Matrices is presented in Appendix D of this document. These matrices present a set of potential display elements for a variety of chart types. Each element has an associated criticality assignment determined by a group of subject matter experts. These criticality levels are intended as guidelines when developing electronic chart applications, but are not mandatory.

It is important to note that the list of display elements for any given chart type is not necessarily complete, nor will every chart of that type include every element in the matrix.

4.1.2.3.5   Assignment of Criticality: The chart file supplier assigns the criticality levels. Criticality levels for information items that are not contained in a matrix may be determined by reference to 4.1.2.3 and consideration of the criticality level of similar items within the matrices. The assignment of criticality levels shall take into account the source information. If a given item is required to be displayed based on the government provided source data for a given procedure, it shall be implemented as a level 1 or 2 requirement, regardless of the rating in the matrices of this document.

To support the dynamic change of criticality levels as new chart information is distributed, criticality levels shall be established or verified and supplied with associated new data at the time of database revision.

4.2   Phase of Flight:

An electronic chart is used to either brief (review) a procedure or to execute a procedure. Which function a particular electronic chart is being used for may be determined by using the definitions of phase of flight below.

4.2.1   Briefing: Prior to the time that the aircraft is actually flying a given procedure, the aeronautical information display requirements are defined as the briefing phase of flight.

4.2.2   Taxi: The taxi phase is the navigation of aircraft on the airport surface. It is anytime prior to the takeoff roll or after the landing. If there is an aborted takeoff, the aircraft is considered to have returned to the taxi phase.

4.2.3   Departure: If an applicable departure procedure has been selected as the flight plan procedure, the departure phase begins at the takeoff roll and ends either when the procedure has been completed or when the procedure is removed from the flight plan.

4.2.4   Enroute: The aircraft is considered to be enroute anytime the aircraft is airborne and no procedure (e.g., SID, STAR, approach, etc.) has been selected as the planned flight procedure. The system is also considered to be in the enroute phase when all selected procedures have been completed. The airplane is considered to be in the enroute phase if a procedure is selected but not in use.

4.2.5   Arrival: If a STAR has been selected as the flight plan procedure, the arrival phase begins when the aircraft has crossed the first point of the STAR or is being vectored to join the arrival. It ends when the procedure has been completed, removed from the flight plan, or when the approach phase has been started. When points are common on both the arrival and approach procedures, the approach phase will be initiated when the aircraft passes over the first common point.

4.2.6 Approach: When either a Charted Visual Approach Procedure or Instrument Approach Procedure has been selected as the flight plan procedure, the approach phase begins when the aircraft has reached the first fix on the approach or is being vectored to intercept the procedure. It ends when any of the following occurs:

- The missed approach procedure has been activated by positive pilot action.

- The aircraft has landed.

4.2.7 Missed Approach: When an Instrument Approach Procedure has been selected as the flight plan procedure, the missed approach phase could follow the approach phase. The information requirements are significantly different during this missed approach phase versus the approach phase. This phase begins when the missed approach procedure has been activated by positive pilot action.

4.3 Display Standards:

Once it is determined what information is required and when, it is necessary to develop the correct level of standardized look to provide a balance between consistency of applications and product innovation. This section provides guidelines for this purpose.

4.3.1 Information Groups: This section will describe what information groups should comprise an electronic aeronautical chart. It will also describe where these groups should be located based on display formats and modes.

The information groups and display locations were strongly influenced by the design of current paper products. An analysis was done of these existing products and is presented in Appendix C. This is not meant to imply that an electronic chart should be rendered to look like a paper chart. Rather it provides for a standard location of charted information as innovative solutions are developed.

Any piece of aeronautical information should be evaluated for which display group it should be located in. A given piece of information may be located in more than one information group.

The information groups are as follows:

4.3.1.1   Chart Heading: The Heading information group contains labeling type information that allows the flight crew to determine the proper procedure has been selected. It includes the following:

- City, State

- Airport

- Airport identifier

- Approach title

- Date

4.3.1.2   Communications: This group includes the communication functions and their appropriate frequencies. Examples include ATIS, ground control, ramp/apron, ARTCC and radar.

4.3.1.3   General Notes: Notes of a general nature that apply to the entire procedure should be included in the notes group. Other notes that are specific to a certain area on the chart should be placed in that area. As an example, restrictions to circling minimums should be placed with the circling minimums. The notes group includes such things as:

- Minimum equipment requirements (radar required, DME required)

- Dual simultaneous approaches

- Altimeter setting source

- Pilot controlled lighting (with frequency)

- Procedural data notes

- Precipitous terrain

- Transition altitude/transition level

- HectoPascals setting

- Circling not authorized in certain sectors

4.3.1.4   Plan View: This view is also known as the birds eye view. This view graphically depicts the lateral navigation portion of the procedure.

4.3.1.5   Time/Distance Tables: This group may include the descent angles as appropriate and also includes descent rates in feet per minute. It may also include the distance and timing to the missed approach point when applicable.

4.3.1.6   Textual Description: When the graphic depiction cannot adequately depict the procedure, a textual description of the procedure should be included. Text should not be included when the graphic depiction is adequate. Other textual material may be included.

4.3.1.7   Profile View: This view is a side view that depicts the airplane desired vertical track with altitudes and distances. A table of recommended altitudes for DME distances may appear at the top of the profile view.

4.3.1.8   Missed Approach Text: The missed approach instructions contain the narrative text that explains the procedure for exercising the missed approach procedure.

4.3.1.9   Missed Approach Icons: All or part of the missed approach procedure can be displayed graphically with the use of icons.

4.3.1.10 Landing Minimums: The minimums section includes the landing minimums expressed as minimum altitudes and visibility distances that are used under various circumstances.

4.3.1.11 Other Minimums: This group contains the other minimums such as alternate minimums, takeoff minimums, radar minimums, and obstacle departures.

4.3.2   Group Locations: Information groups should be displayed in consistent locations in order to enhance the ability of the flight crew to find information within and across platforms. Rather than defining absolute locations, a set of relative locations are defined. In addition, the relative location of a given information group can vary based on the display format (see 4.3.4). Table 1 defines the relative locations for each display group.

TABLE 1 - Display Group Locations

Approach Charts	Fixed Chart Format	Moving Chart Format
Heading	Top of display.	Top of display.
Communications	Below the heading and generally above the plan view. As an alternative, the communication information may be located on a separate display.	Below the heading and generally above the plan view. As an alternative, the communication information may be located on a separate display.
Missed approach text	Generally after communications and prior to general notes.	When displayed, generally after communications and prior to general notes.
General Notes	Below communications and heading and generally above the plan view. General notes may be placed in more prominent locations if deemed necessary by the chart designer.	When displayed, below communications and generally above the plan view. General notes may be placed in more prominent locations if deemed necessary by the chart designer.
Plan View	The plan view is the most prominent feature on the display and other groups are in relation to this group.	The plan view is the most prominent feature on the display and other groups are in relation to this group.
Profile View	Below Plan View	Below Plan View
Missed approach icons	The use of icons is optional, and is intended to provide tactical information for the initial portion of the missed approach. When included, they should be prominently displayed.	Missed approach icons, when displayed, will be in a prominent location. It is acceptable to be on a separate display in the pilot's primary field of view.
Landing minimums	Generally below the profile view.	Only the relevant minimums should be displayed.

4.3.3   Information Groups for Charts: For each type of chart (e.g., airport diagram, enroute, etc.), the information groups described above may or may not be applicable. Table 2 shows which charts generally use which information groups. Certain information groups may not be required under some circumstances, such as the time distance table may not be required based on aircraft equipage.

(Table 2 does not necessarily address all the current chart types.)

TABLE 2 - Chart Display Group Requirements

Information Groups	Chart and Procedure Types					
	Airport Diagram	Departure Procedure	Enroute Chart	Arrival Procedure	Precision Approach	Non-Precision Approach
Heading	R	R	O	R	R	R
Communications	R	R	R	R	R	R
Notes	R	R	R	R	R	R
Textual Description	R	R	R	R	NA	NA, except O for visual
Plan View	R	R	R	R	R	R
Profile View	O	O	NA	O	R	R
Landing Minimums	NA	NA	NA	NA	R	R
Missed Approach	NA	NA	NA	NA	R	R
Time/Distance/Climb Rate Table	NA	R	NA	NA	O	O
Airport Sketch	NA	NA	O	NA	O	O
Takeoff Minimums	O	O	NA	NA	NA	NA
Alternate Minimums	O	NA	NA	NA	O	O
Radar Minimums	NA	NA	NA	NA	O	O

Note: If an information group is shown as required "R" but no information is applicable for a specific chart, the R is not applicable.

Legend:

R = Required to be included
O = Optional
NA = Not applicable

4.3.4 Display Formats: While paper charts come in basically one format, electronic charts may offer the ability to utilize different display formats to meet the multiple needs of the flight crew. To maintain the simplest system, it is recommended that the number of display formats be limited as follows:

4.3.4.1 Fixed Chart Format: The fixed display format is designed to provide information in a format that is similar to existing paper charts. The fixed chart has the following characteristics:

- Displays information for one chart at a time.

- The plan view is a fixed geographical area that shows all the plan information in a north up orientation. This area should be initially centered on the display so as to present the entire procedure, and may be panned, scrolled or zoomed as described in 4.4.4.

- The display location of the information groups should comply with the requirements of 4.3.2.

This format is designed to best support the following flight crew tasks:

- Perform a flight crew briefing of any given instrument procedure.

- Provide a display from which information can be quickly accessed to accommodate changing requirements.

While not necessarily the optimum format for a moving map display, the fixed chart format also provides all necessary information required for the flight crew during the tactical phase of executing an instrument procedure.

All electronic aeronautical chart display systems shall include a fixed chart format. It is acceptable to implement only a fixed chart format and meet the requirements of an electronic aeronautical chart display. If the designer can show that the requirements of the fixed chart and fixed full chart formats, including the requirement to initially display all the chart file information, can be accomplished using only a moving chart format as described in 4.3.4.2, the fixed chart format may not be required.

4.3.4.1.1 Fixed Full Chart Format Display: The Fixed Full Chart format provides a means of showing all the information the issuing authority, procedure developer and chart designer determined was necessary for the pilot to completely understand the particular chart or procedure. The Fixed Full Chart shall initially display all of the information contained in the chart file, to ensure that the flight crew reviews the entire chart. In its basic form, this could be a replica of a paper chart.

4.3.4.1.1   (Continued):

Information that clearly will not be used for a given operation need not be initially displayed. Some examples are:

- Approach category minimums lower than that required for the aircraft (e.g., Category A or B minimums for a Category C aircraft) do not need to be initially displayed. Category D minimums must be retained because they may be used at the operators' discretion.

- Category III weather information may be removed when the equipment and/or operator is limited to Category I or II flight operations.

- For SIDs and STARs, only the applicable information relative to the planned route of flight is required to be shown when the chart is initially displayed.

When the fixed full format does not initially display all the information contained in the chart file, a means shall be provided to access and view the other information.

4.3.4.1.2   Fixed Chart Decluttered Display: The Fixed Chart may be decluttered by removing and adding information within the limitations and parameters described in 4.4.3. This decluttering may be done by the flight crew or automatically by the chart display system. Some examples are:

- Removing the DME arc transition when the procedure turn is to be flown.

- Displaying only the appropriate minimums for the approach to be flown.

4.3.4.2   Moving Chart Format: The moving chart format is intended to provide tactical charted information required for the task of executing an instrument or visual procedure. As described here, the moving chart is not a substitute for a primary navigation display. The Moving Chart has the following characteristics:

- Displays applicable information from selected charts in a seamless (to-scale) fashion for the intended route of flight. As an example, the last leg of a STAR and the first leg of the approach may be displayed simultaneously.

- The plan view is a dynamic geographical area that can be selected in either a north up or heading/track up orientation. The geographical area displayed on the plan view may be changed by panning and changing the range within the limits described in 4.4.4.

- The display location of the information groups should comply with the requirements of 4.3.2.

4.3.4.2 (Continued):

While the fixed chart format allows the flight crew to access any given procedure at any time, the moving chart is intended to show only the information that is relevant to the procedure(s) in use. This format should take maximum advantage of the various decluttering methods and use of graphics.

4.3.4.2.1 Moving Chart Information Decluttering: The Moving Chart format is intended to show only the applicable information relative to the procedure or chart currently in use. For example, any route information that is not intended to be flown (e.g., DME arc if the routing is vectors to intercept the final) should not be shown on the moving chart display. Section 4.4.3 provides further detail on chart decluttering.

4.3.4.2.2 Moving Chart Format Additional Requirements: To provide proper situational awareness, attributes of a moving map may need to be incorporated into the moving chart display. Reference "Minimum Operational Performance Standards for the Depiction of Navigational Information on Electronic Maps", RTCA document DO-257A.

4.3.4.2.3 Seamless Transition on Moving Chart: Whereas the fixed format displays one procedure at a time (much like classical paper charts), the moving chart depiction is meant to display aeronautical information in a continuous stream as appropriate at any given time. The following requirements are necessary for the proper flow of this information:

- Present Position - Aircraft positional information must be supplied to the electronic chart system.

- Phase of Flight - As defined in 4.2, the phase of flight should be used to determine the proper time for display of aeronautical information.

- Overlapping Procedures - When two procedures overlap, a means shall be provided to insure that the proper information is presented to the flight crew. The electronic chart display system may need to alert the flight crew that there are overlapping procedures. A means shall be provided for the flight crew to select the appropriate procedure if necessary. It is the pilot's responsibility to ensure the appropriate information is displayed.

- Fixed Chart Access - The ability to quickly switch to the fixed chart format for a given procedure shall be provided.

- Sequencing of the Display of Information not in the Plan or Profile Display - Information such as communication information, approach minimums, etc., should be displayed as appropriate, based on phase of flight. Some of this information may need to be displayed prior to sequencing from one procedure to another, in order to be presented to the flight crew when required.

4.3.5   Display Features: Except as noted, the following set of display features apply to both the fixed and moving chart formats.

4.3.5.1   Aircraft Overlay: When aircraft present position is available, an aircraft symbol may be overlaid on the plan and/or vertical profile portions of the electronic chart display. The aircraft symbol should be drawn such that it is easily recognized by the flight crew, and should be directional such that it can be oriented to properly represent aircraft heading/track.

The aircraft position overlay should be prohibited if the chart display is not to scale. If the aircraft position subsequently becomes unreliable or invalid, the aircraft overlay shall be removed and that failure indicated to the flight crew.

4.3.5.2   FMS/GPS Flight Plan Overlay: If available, the FMS/GPS flight plan may be overlaid on the electronic chart provided it is clearly distinguishable from the electronic chart. Where the FMS/GPS flight plan legs match the charted procedure legs, the symbols for the electronic chart should be retained.

4.3.6   Scaling:

4.3.6.1   Rendering to Scale: Display elements that have an associated latitude and longitude should be rendered in the actual geographic location whenever possible. Routes, courses, tracks, etc. associated with elements that have specified latitude and longitude should be rendered in their actual position.

4.3.6.2   Rendering Not-to-Scale: For the purposes of this document, a display is considered not-to-scale if a display element with an associated latitude and longitude is rendered in other than its actual position.

4.3.6.2.1   Indicating Not-to Scale Depictions: Symbols with an associated latitude and longitude may be rendered in other than their actual position provided they are clearly indicated as not-to-scale.

4.3.6.2.2   Schematic Renderings: Symbols which depict an airspace procedure (e.g., holding, procedure) may be displayed schematically and are not required to be drawn to scale, or labeled as not-to-scale.

Other certification requirements will need to be considered if an aircraft symbol is overlaid on a not to scale schematic rendering.

4.3.6.2.3   Insets: An inset may depict a different geographic area than the rest of the plan or profile view (e.g., the depiction of the missed approach holding fix on the fixed chart format). These areas shall be clearly indicated. The aircraft position overlay may be displayed again, once the aircraft is within those geographic boundaries.

4.3.6.2.4   Moving Chart Format: Display elements should be rendered in their actual position on a moving chart format. Items may be rendered in other than their actual position as long as they are clearly indicated as not to scale and do not impact situational awareness.

4.3.7   Symbology: Symbols used for electronic charts should conform to the standards defined in ARP5289. As new requirements for charting symbology are defined, ARP5289 may not be current in addressing the new requirements. The chart designer/database supplier should research other industry standards or industry committees that may be addressing the same need. The generation of a new symbol should be done with industry, government and other international standards cooperation as much as possible.

4.3.8   Color: There is no single set of standards that can define appropriate color usage for electronic charts. However, there is historical color usage in existing aeronautical paper charts and aircraft electronic displays. The design of any electronic chart display should develop a color philosophy that takes into account the currently used electronic display color philosophy and balance that against historical usage of color on paper charts. The following are some guidelines to assist in developing a color philosophy for electronic charts.

Further guidance on color standards is available from material published by other organizations (e.g., SAE, RTCA, FAA, ISO, EASA, ICAO).

4.3.8.1   General Color Use: The principal use of color is to add contrast and to aid in an overall search task. The following rules should be followed when assigning colors:

- Color should not be the sole means of differentiating objects.

- Symbols that need to be differentiated by group should not have the same color (e.g., NDBs and VORs).

- Color change may be used as an additional means of indicating a change in condition. This may include alerts, NOTAMs, proximity to restricted airspace, etc.

- The number of colors used to differentiate between major groups of aeronautical information such as VORs, NDBs, airport symbols, etc., should be limited. For additional information, such as shading, accents, boundaries, etc., the number of colors used may be greatly expanded.

- Different shades of the same color may be used to aid in distinguishing different aspects of like information. For example, different shades (intensities) of brown may be used to show different levels of terrain. Shading may be used to distinguish different aspects of information, but any such implementation should be tested in all lighting conditions. Small differences in shading may not be perceptible.

4.3.8.2 Use of Red, Amber and Yellow: Electronic aeronautical chart displays should limit the use of the colors red, amber and yellow to conform to the standard use for warnings and cautions. These colors are used to highlight information that meets the following definitions:

- Red - Any item displayed in red should indicate a serious problem that if not corrected (or taken into account) immediately, can cause serious injury or loss of life.

- Amber - Any item that is displayed in amber indicates a problem that if not corrected or taken into account properly in the near future, may cause injury. Examples include use of an out of date chart, or for a dual system, when the left and right displays are not synchronized.

- Yellow - The use of yellow should be limited because it may be interpreted by the flight crew in the same manner as amber.

There may be some overriding considerations when applying the use of red and yellow in an electronic chart display, which may need to be considered. The following are some examples:

- Yellow has been an historic color for city patterns on VFR aeronautical charts. When used in an integrated electronic system, this could be confused with weather radar returns and/or terrain warnings.

- In some cases, the color yellow may be desirable to represent real world conditions, such as taxiway strip colors.

- The various warning and caution notes that may appear on a chart should not be displayed in amber, yellow or red. It may, however, be applicable to use red, amber or yellow to alert the flight crew if the conditions in the warning/caution are about to be violated.

4.3.8.3 Color Use on Stand Alone and Integrated Systems: For stand-alone electronic chart systems, a consistent color philosophy should be developed and followed. The use of red and amber/yellow may be able to be used in a manner more consistent than with aeronautical paper charts. For an electronic chart system that is integrated with other flight deck displays, the color philosophy should match the color philosophy of the entire flight deck as much as practical.

4.3.9 Electronic Chart Interpretation Requirements: An electronic chart shall be functionally equivalent to paper charts in terms of interpretability. This shall be accomplished from the normal pilot positions, with minimal display manipulation (e.g., zooming, manual decluttering, etc.) required.

4.3.9.1   Information Density: Although the amount of information for any given electronic chart may be quite large, the display of this information shall meet the requirement of 4.3.9. Sections 4.4.3 and 4.4.5 discuss methods of reducing the amount of information that may be required at any given time.

4.3.9.2   Visual Conflicts: Elements rendered on an electronic display may visually conflict with each other. These visual conflicts shall be resolved to the extent required to meet the requirements of 4.3.9. Section 4.3.10 discusses methods of visual conflict resolution.

4.3.9.3   Display Format: The fixed and moving display formats (see 4.3.4.1 and 4.3.4.2) are designed for different flight crew requirements and have different readability requirements.

4.3.9.3.1   Fixed Chart Format: The fixed chart format shall meet the readability requirements of 4.3.9.

4.3.9.3.2   Moving Chart Format: Due to the dynamic nature of the moving chart format, it may be difficult to keep information from overlapping at all times. At a minimum, a means shall be provided to allow the crew to access and correctly interpret the tactical information.

4.3.9.4   Display Characteristics: The following display characteristics must be considered when designing an electronic chart. Numerous documents exist that provide guidance in these areas.

- Text Font/Size

- Line Specification

- Luminance

- Contrast

- Display Size

- Resolution

4.3.10 Visual Conflict Resolution: Experience with electronic moving map displays has shown that the use of simple graphic placement algorithms that do not attempt to resolve visual conflicts between display elements will result in overlapping data on the map display. Use of these same algorithms for an electronic chart will normally produce a display that does not meet the requirements of 4.3.9.

This section discusses two conceptual methods for resolving visual conflicts, which may be used individually or in concert.

4.3.10.1 Composition Parameters: Composition parameters define how a particular display element or set of elements may be rendered. These parameters may be defined in a variety of methods, including the following:

- A set of default locations, sizes and priorities for the placement of display elements (e.g., the label for a VOR symbol should be located at the 2 o'clock position).

- A range of locations for a display element (e.g., the label for a VOR symbol should be located between the 12 o'clock and 6 o'clock position within 0.25 inches of the symbol).

- A set of specific instructions on display element location, size, and/or priority (e.g., the label for the XYZ VOR must be located at the 4 o'clock position, 0.125 inches from the center of the symbol).

4.3.10.2 Display Algorithms: Algorithms used to render display elements on an electronic chart display should strive to detect and resolve visual conflicts, including those described below.

4.3.10.2.1 Overlapping Attributes: Display elements such as VORs, runways, etc., are located at their respective geographic locations. The attributes associated with these symbols (e.g., labels, pointers, etc.), may be positioned as required to avoid overlapping with other attributes.

4.3.10.2.2 Prioritization of Symbology: If display elements end up overlapping, the more important display element should not be covered up by the less important element. The importance of each display element may change depending on the phase of flight.

4.3.10.3 Relationship of Composition Parameters to Display Algorithms: While it may be possible to produce an electronic chart that meets the requirements of 4.3.9 using only composition parameters or display algorithms, generally the two will have to be used together. A hypothetical process for the fixed chart format is described below:

- The display algorithms initially render the display elements within the limits set by the composition parameters.

- The display is evaluated for interpretability against the requirements of 4.3.9.

- If required, specialized composition parameters are developed to place and size specific display elements in a manner to resolve visual conflicts not resolved by the display algorithms.

4.3.11 Display Device Locations: The electronic chart may be displayed on a variety of devices in the flight deck. Guidance on acceptable display locations may be found in the Electronic Flight Bag Advisory Circular 120-76A.

4.3.12 Relation to Navigation Display: The electronic chart display as defined in this document, is not intended to replace the primary navigation display on the flight deck. While the electronic chart information provides much of the information required to execute an instrument procedure, it does not provide the information required for navigation course guidance.

4.3.13 Chart Projection: Since the use of the electronic chart is different from the paper aeronautical chart, there is no need to establish a standard aeronautical chart projection for electronic charts. The electronic chart manufacturer should choose a projection (or set of projections) that provides a uniform scale throughout the display.

4.4   Control Standards:

This section will present a set of guidelines that lead to a human interface providing an appropriate level of consistency for the flight crew from one manufacturer's implementation to another. It will not require any specific type of control, but will provide standards that should apply to all types of control devices, including discreet controls, graphical interface and voice control. Unlike the display of charting information, electronic display controls have little equivalent in paper charts to use as a historical guide.

4.4.1   Chart Indexing:

4.4.1.1   Airport Organization: A pilot selects terminal procedures based on the airport. Consequently, procedures should be indexed and retrieved by airport. In order to reduce the potential for selecting a chart for an incorrect airport, a listing of electronic charts should be available from only one airport at a time.

4.4.1.2   Electronic Chart Index: For each airport, electronic charts should be organized into the following indices:

4.4.1.2.1   Airport: Includes any chart that contains information on airport layout, taxi procedures, or other airport information. Takeoff and alternate minimums should be included as a sub-index under the airport index.

4.4.1.2.2   Departure: Includes textual and graphically charted departure procedures.

4.4.1.2.3   Engine Out Departure: The Engine Out Departure index may be included as a part of the Departure index.

4.4.1.2.4   Arrival: Includes textual and graphically charted arrival procedures.

4.4.1.2.5   Approach: Includes instrument approach procedures, charted visual approach procedures, vicinity charts, and special circling procedures.

4.4.1.2.6   Noise: Includes noise abatement procedures.

4.4.1.2.7   Other: Electronic charts should be organized in the above indices so long as it is logical to do so. If specific charts exist that do not logically fit, other indices may be created as necessary to accommodate special needs of a given electronic chart system.

4.4.1.3   Enroute Chart Indexing: Unlike instrument approach procedure charts, enroute charts are not necessarily defined by fixed geographic areas. Accessing enroute information may be done by various search methods, including airport, city, navigation aids, defining a geographic area, etc.

4.4.2   Chart Selection: The system should be able to take a minimum amount of information from the flight crew to either directly select a chart for display, or lead the flight crew to the desired chart. The intent is to define the sequential steps required to select a specific chart that is associated with an airport.

4.4.2.1   Airport Search Engine: The first step in selecting a chart is to identify the associated airport. A specific airport shall be retrievable by ICAO identifier. To retrieve an airport without knowing the ICAO identifier, one or more of the following search methods should be available:

1.   IATA identifier.

2.   Airport name or a portion thereof.

3.   City/town, state, province, country name.

4.   Selection from the chart map

5.   A search of all airports within a selected radius of a selected latitude/longitude including present position.

4.4.2.2   Chart Selection: Once the airport of interest has been determined, the desired chart or set of charts can be selected.

4.4.2.2.1   Chart List: The list of available charts for a given airport should be organized as described in 4.4.1.2. Other pertinent information may be contained in this list to aid in the planning process.

4.4.2.2.2   Single Chart: Once the desired chart is selected from a chart list, it should be displayed in the fixed full chart format, as described in 4.3.4.1.1.

4.4.2.2.3   Individual Chart Selection: Each electronic chart system shall provide a means for the flight crew to select any chart in the database regardless of previous selections.

4.4.2.3   Flight Plan Chart List: As an option, the electronic chart system may provide the ability for the flight crew to create a sequential list of the aeronautical charts to be used for the entire flight. This list may be created by direct pilot selection through the chart system or by input from a FMS/GPS. Creation of this set of charts will enable certain advanced features to be enabled.

4.4.2.3.1   Automatic Chart List Designation: If an appropriate interface exists, the electronic chart system should use the information from the designated flight plan to pre-load the appropriate chart into the designated list. The electronic chart system should allow the ability to select charts into the designated list that are not a part of the FMS/GPS flight plan.

4.4.2.3.2   Active Procedure Override: For those electronic chart features that utilize the designated chart list, a means shall be provided to override the current active procedure with another procedure at any time in the event the incorrect procedure is in use.

4.4.2.3.3   Transition on Moving Chart Format: Information on the moving chart format is intended to sequence automatically based on phase of flight as described in 4.2. Additionally, a means to manually command a transition to the next procedure should be offered.

4.4.2.3.4   Transitioning Fixed Format Charts: Automatic sequencing from one fixed format chart to another e.g., STAR to IAP, is not recommended. However, alerts to indicate that a procedure is nearly complete, prompting the pilot to select or execute a subsequent chart selection is acceptable.

4.4.2.3.5   Active Procedure Alerting: For systems that have an active flight plan input (manual or automatic), anytime a SID, STAR or Approach (visual or instrument) procedure is active and another procedure of the same category is being displayed (e.g., the active approach is ILS 8R and a pilot is viewing the ILS 8L), an alert of this condition should be provided to the flight crew.

4.4.2.4   Access to Other Procedures: When a procedure is being flown, the flight crew may preview and tailor another procedure. However, a means to quickly retrieve the active procedure shall be provided.

While viewing any given chart, the time required to access other charts that may be used in the near term should not be excessive.

4.4.2.5   Chart Effective Date: There needs to be a means for the flight crew to determine the effectivity of the chart being used.

4.4.3   Chart Decluttering: When displaying aeronautical information on an electronic display, there are numerous opportunities to declutter the display by removing information that is not required at a particular time or for any given set of conditions. While this decluttering is not required, it can increase readability and improve the ability of the flight crew to find the information they need that is applicable to the execution of the procedure. The section provides guidelines to achieve the following:

- Ensure that information required by these guidelines cannot be removed from the display.

- Provide a standard hierarchy of decluttering methods.

- Prevent information content from being changed.

4.4.3.1   Declutter by Route: Route information that is not applicable to the flight plan may be removed from the display when appropriate, regardless of its assigned criticality. Analysis of existing paper charts has shown that the ability to remove this type of information can provide the greatest amount of reduction in displayed information. To utilize this feature, the electronic chart system must have the ability to designate or recognize the intended route of flight, including procedures, transitions and airways.

In cases where the aircraft is being radar vectored to final, the option of deselecting all the transitions to the approach may be offered.

4.4.3.1.1   Route Changes: For changes in assigned routing, a means should be provided to display the applicable route information that had been previously decluttered.

4.4.3.1.2   Manual Route Designation: The electronic chart system may allow for the pilot to directly input the flight plan route.

4.4.3.1.3   External Route Designation: If an appropriate interface is available, the electronic chart system may accept inputs from external sources, e.g., FMS, GPS or datalink input, to determine the flight plan routing.

4.4.3.2   Declutter by Equipage: Certain information may be removed from the display based on aircraft and/or ground equipment configuration and status. This information may be removed from the display regardless of the criticality level.

4.4.3.2.1   Aircraft Category: If the category of the aircraft is known, any information that is only applicable to other categories e.g., category C landing minimums for a category D aircraft, may be removed.

4.4.3.2.2   Aircraft Equipment: If information is clearly determined not to be required due to aircraft equipage, it may be removed. This may be based on equipment that is not installed as well as equipment that is installed. The following are examples of acceptable decluttering by equipage:

- If the aircraft is not RNAV equipped, the RNAV routes may be removed.

- If the aircraft is RNAV equipped and the route is being flown by RNAV, the VOR or ADF attributes, such as frequency, Morse code, and class of navaid, may be removed by pilot action.

- If an approach is being flown using RNAV systems, the raw data information used for identifying intersections and fixes may not need to be displayed full time, but should be accessible to monitor the approach using raw data.

The aircraft equipment configuration may be determined in a number of ways:

- Flight crew input.

- Preprogramming the system with a particular aircraft's equipment configuration.

- Integration with other aircraft systems to determine configuration.

4.4.3.2.3   Aircraft Equipment Failure: If information has been removed based on installed equipment, a method shall be provided to either manually or automatically recall this information in the event of a failure of the installed equipment.

4.4.3.3   Declutter by Chronology: In general, information that is relevant to a point behind the aircraft may be removed regardless of its criticality, as long as it has been ascertained it is no longer required by the flight crew. The following are examples of information that may be removed.

4.4.3.3.1   Fix Formation Information: Fix formation information, such as radials/bearings and distances that define a fix, may be automatically turned off once the fix has been passed.

4.4.3.3.2   Fix Information: Normally, the fix immediately preceding the active fix should be retained. Other fixes that have been passed may be removed if no longer required for situational awareness or other flight crew needs.

4.4.3.4   Declutter by Criticality: Information that cannot be removed by any of the methods described in 4.4.3.1 through 4.4.3.3, has the potential to be removed from the display based on its criticality level.

4.4.3.4.1   Level One Criticality Items: Level one-criticality items that cannot be removed by other decluttering methods shall remain displayed.

4.4.3.4.2   Level Two Criticality Items: Level two criticality items shall be initially displayed, and may be removed only by flight crew action.

4.4.3.4.3   Level Three Criticality Items: Level three criticality items need not be initially displayed, and may be removed either automatically or by flight crew selection.

4.4.3.4.4   Phase of Flight Transitions: As discussed in 4.2, criticality of aeronautical information changes based on whether the particular procedure is being briefed or executed, which is determined by phase of flight. When the criticality for a given item changes due to this phase of flight transition, the following rules apply.

- Any item that changes to a higher level of criticality at a phase of flight transition shall be automatically displayed if it has been selected off (e.g., in the transition from approach to missed approach).

- Items that do not change criticality level at a phase of flight transition should remain in their current display state.

- Items that change from a level 1 to a level 2 criticality at a phase of flight transition shall remain displayed and may subsequently be selected off.

- Items that change to a level 3 at a phase of flight transition may be automatically removed from the display.

- New items that were not applicable to the previous phase or procedure shall be initially displayed if they are a level 1 or 2 criticality.

4.4.3.5   General Decluttering Guidelines: This document does not specify the specific methods to be used for decluttering the information displayed on an electronic chart. This section does, however, provide some guidelines to be used when designing the specific decluttering controls.

4.4.3.5.1   Recalling Decluttered Information: A means shall be provided to recall decluttered information.

4.4.3.5.2   Retrieving Information Not Initially Displayed: A method shall be provided to retrieve information not initially displayed on the fixed chart format as described in 4.3.4.1.1.

This information may also be retrievable in the moving chart format.

4.4.3.5.3   Declutter Status: If the ability exists to declutter a chart, there shall be a clear indication to the flight crew of the declutter status.

4.4.3.5.4   Layering Like Information: A common method for decluttering moving map displays is allowing layers of like information (e.g., VORs, Airports, etc.) to be turned on or off at the same time. If this method is used for an electronic chart, level 1 items in a layer shall not be deselected.

4.4.3.5.5   Zoom and Pan Affects on Decluttering: If the chart display allows the flight crew to zoom and/or pan a chart display, it may cause some items that are level one criticality to be moved out of the field of view. In most cases, this is acceptable since the simple action of changing range or panning will bring the information back into view.

4.4.4   Basic Control Features: The following describes certain basic display controls that are allowable on all electronic chart displays.

4.4.4.1   Range Control/Zooming: To provide the flight crew the ability to quickly view information in more detail or to view the information not currently displayed on the plan view, the ability to zoom in and out of a particular portion of the display should be provided.

4.4.4.2   Panning/Scrolling: The ability to pan or scroll the map to a new center point without changing the range or scale of the display may be provided. If this feature is included, a means should be provided to keep the flight crew aware of where the aircraft is (if aircraft position is overlaid) with respect to the display center.

4.4.5   Chart Format Selection Guidelines: This section provides guidelines for the selection of chart formats when viewing electronic charts. Figure 1 provides a simplified diagram to illustrate a concept for the initial chart display and possible transitions from one format to another based on the guidelines of this section.

Simplified Chart Format Selection Concept Diagram (Assumes Single Display System)

Display not in Chart Mode

Is there an active chart? (Chart List or Single Chart Selected) — N → Chart Index

Y

Has the selected chart been briefed? — Y

N

Return to Previous Format

Fixed Full

Fixed

Moving
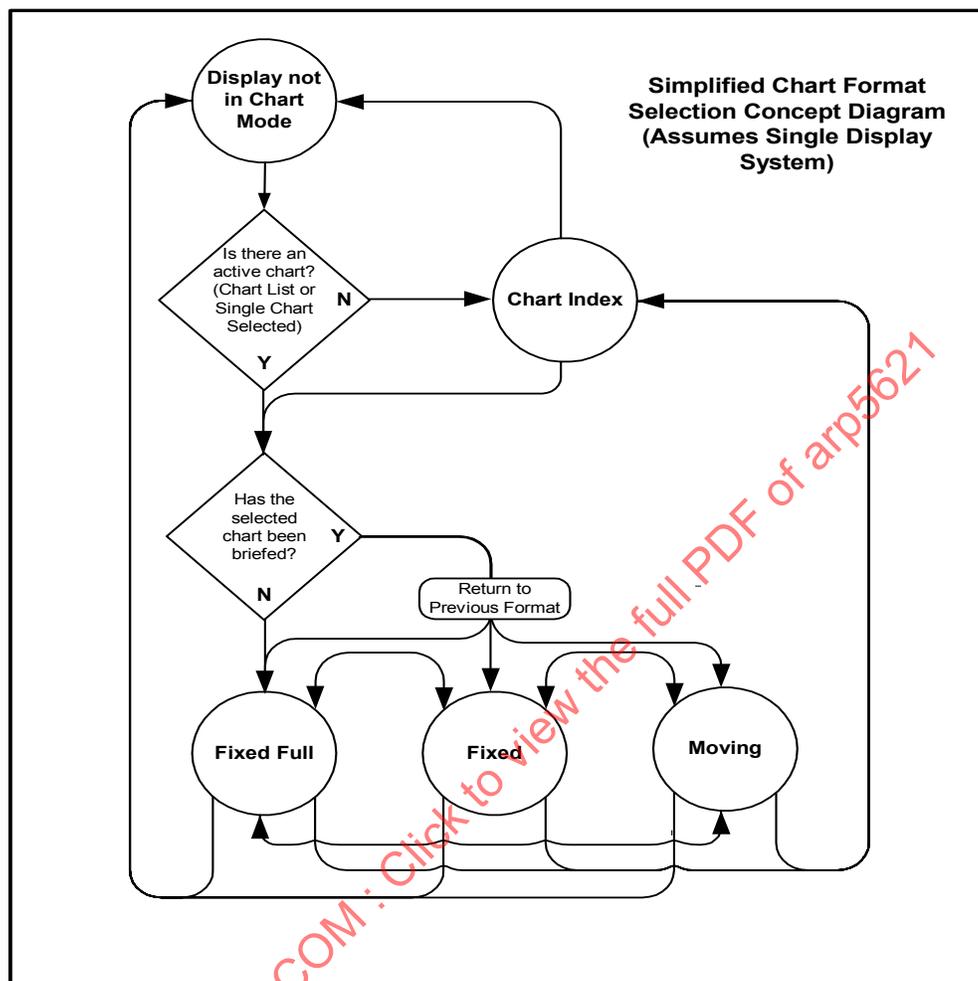
FIGURE 1 - Chart Format Selection Concept Diagram

4.4.5.1 Initial Chart Selection: To ensure that the flight crew is provided the proper opportunity to review all the information the procedure/chart designer determined to be important, the first time any procedure (e.g., SID, STAR, approach) is viewed, it should be viewed in the fixed full chart format as defined in 4.3.4.1.1.

4.4.5.1.1 Initial Chart Selection in Moving Chart Format: If a chart is initially viewed in the moving chart format, an alert should be provided to the flight crew that the chart has not been briefed in the fixed full format.

4.4.5.2 Reselection of a Decluttered Chart: If a chart has been decluttered and then another chart or display page is selected, any subsequent selection of that chart should retain the last decluttering status for that flight.

4.4.5.3   Chart Display Format Selection: If a chart has been decluttered in the fixed format, the declutter state should be automatically applied to the moving chart format.

If a chart has been decluttered in the moving format, then the declutter state should be automatically applied to the fixed chart format as long as it has been previously viewed in the fixed full format.

4.4.5.4   Reversion To Fixed Full Format: The fixed full format shall be able to be quickly accessed from any other chart format as defined in 4.3.4.1.1.

4.4.6   Control of Enroute Charts: The control guidelines presented in the preceding portions of 4.4 are based on the control of discreet charted procedures, e.g., SIDS, STARS and IAPs. Many of these guidelines are also applicable to an enroute chart display, but the electronic chart producer should carefully review them for applicability to the enroute chart.

4.4.7   Multiple Chart Display System Considerations: When more than one electronic chart display system is installed, there are flight crew operational issues that must be considered. The guidelines of this section assume some level of communication between the two systems. The guidelines of this section are not intended to replace traditional crew resource management techniques (CRM), rather to supplement them. If multiple independent systems are installed, then the guidelines of this section may be covered by CRM techniques.

4.4.7.1   Displayed Procedure Comparison: If the pilots are viewing different procedures, an indication of this condition should be provided prior to flying the actual procedure.

4.4.7.2   Flight Plan Designation: If the system has a manual flight plan input, this information may be cross-linked to other electronic chart systems.

4.4.7.3   Chart Decluttering: A means to allow one display system to accept decluttering inputs from another system may be provided. If this capability is provided, the electronic chart producer should evaluate the need to alert that a change has been made on one system from the other.

4.5   Chart System:

While this document has used system configuration concepts in determining the display and control standards, it is not a complete description of the hardware/software configurations. FAA Advisory Circular 120-76A provides a description of hardware and software configuration and certification requirements for a broad range of equipage.

4.6   Notice to Airmen (NOTAMs):

Internationally, ICAO Annex 15 (Aeronautical Information Services) defines the overall processes to be followed to distribute permanent as well as temporary changes. In practice, the term NOTAM is applied to a broad range of information.

4.6.1   NOTAM Examples:

4.6.1.1   State Issued NOTAMs: NOTAMs issued by host countries. These NOTAMs are generally issued in accordance with ICAO Annex 15.

4.6.1.2   Supplier NOTAMs: The producer generally issues these NOTAMs when they determine there is a change required that is specific to their product.

4.6.1.3   Company NOTAMs: An individual operator issues these NOTAMs that are specific to their company operations.

4.6.2   NOTAM Availability: NOTAMs are provided by national and international network systems and pilots are required to obtain this information prior to each flight. This system provides a means to access all state issued NOTAMs, but may not cover other NOTAMs.

For an electronic chart system, a means must be provided to communicate supplier NOTAMs to the user in a timely fashion.

If available, NOTAMs of all types, may be provided either as a database revision prior to flight and/or via a data-link to the aircraft.

4.6.3   NOTAM Applicability: Only a portion of all NOTAMs are applicable to any given flight. The current NOTAM system does not easily accommodate the determination of applicability. It is desirable to filter out NOTAMs that are not applicable.

Some of the factors that determine NOTAM applicability are:

4.6.3.1   Temporal Effectivity: NOTAMs that apply to the time period of the planned flight, including reasonable delays, are applicable.

4.6.3.2   Equipage: NOTAMs that relate to aircraft equipage are applicable.

4.6.3.3   Category: NOTAMs that relate an aircraft's category or class are applicable.

4.6.3.4   Geographic Area: NOTAMs pertaining to the route of flight and any reasonably expected diversion area are applicable.

4.6.3.5   Planned Altitude or Flight Level: NOTAMs pertaining to the planned flight altitude are applicable.

4.6.3.6   Airport Surface: All NOTAMs pertaining to movement and non-movement airport surfaces of the destination, arrival and alternate airports are applicable.

4.6.4   NOTAM Information Display: The following are acceptable means of providing the pilot with applicable NOTAM information:

1.   Textual NOTAMs

2.   Graphic NOTAMs

Textual NOTAM information may be provided via the electronic chart display or a hard copy media such as paper. Additionally, the electronic chart may be amended to provide NOTAM information in a symbol or non-textual format (e.g., information about a closed taxiway may be provided textually or by amending the applicable taxiway on the airport chart to graphically indicate closure). (Technical standards for data link update of graphical TFR and airport NOTAM overlay information may be found in RTCA's DO-267A.)

4.6.4.1   Amended Chart Features: When a chart feature is amended by a NOTAM, the amended feature should not be removed unless the NOTAM indicates a permanent change. For a temporary change, the feature symbol should be overwritten or annotated to indicate the change in status, (e.g., a runway closed for maintenance may be indicated by a series of Xs on top of the runway symbol). Future SAE standards may be developed to standardize a set of NOTAM symbols.

4.6.4.2   Pilot Annotations to Electronic Charts: A means may be provided for the pilot to annotate an electronic chart. This annotation may reflect a NOTAM that is not displayed on the electronic chart, company specific notes not incorporated on the chart, or other information. Annotations include the addition of text, obstacles, and pilot unique symbols.

When a means is provided to the pilot to annotate an electronic chart:

- A pilot shall not be able to amend or remove any feature or text from a chart

- The annotation shall have a unique format making it readily distinguishable as a pilot entry.

- The annotation shall not be displayed for subsequent flight cycles unless specifically retrieved by the pilot.

5. CHART GENERATION COMPONENTS:

The infrastructure requirements, e.g., database, graphics, etc., for implementing an electronic chart system as described in this document may be accomplished in many different ways. As shown in Figure 2, three major components are anticipated in the chart generation process.
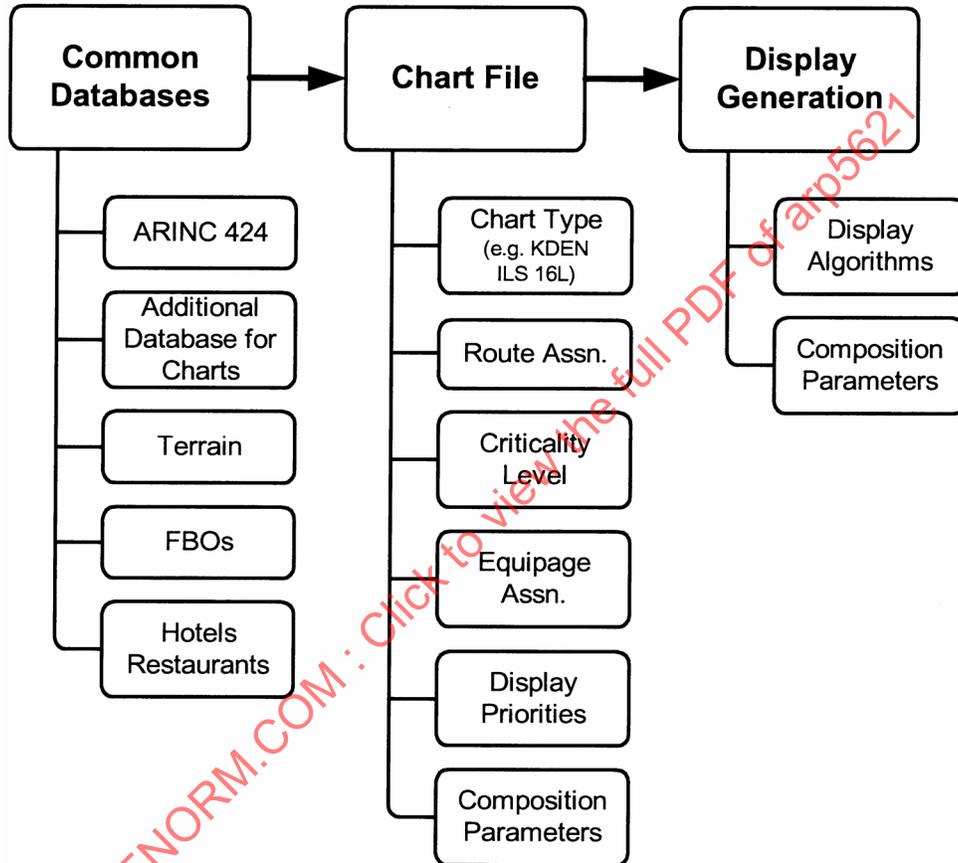
FIGURE 2 - Chart Generation Components

5.1   Common Database:

An electronic chart system accesses a common database or series of databases (e.g., 424 database) for detail information that will be used in conjunction with the chart file. The common databases contain information that is not chart dependent (e.g., latitude/longitude of a VOR).

5.2   Chart File:

A unique chart file will define each charted procedure. The chart file in its simplest form is a listing of every display element that comprises an individual electronic chart and the various attributes and rules unique to the chart. These may include:

- Chart Type

- Route Association

- Equipage

- Criticality

- Display Priority

- Composition Parameters

It is expected there will be few chart file providers and numerous display manufacturers. Assigning these attributes in the chart file will help to ensure a consistent application of the guidelines of this document.

The chart file is considered the core of the electronic chart. The exact structure and content of the chart file will require close coordination between the chart file provider and display providers.

5.2.1   Undefined Objects: As new procedures evolve, there is often a need for new symbols or graphics that may not be defined in the database or graphics system. This part of the chart file would define a new symbol or set of drawing instructions that the display system could use to render this new requirement. This part of the chart file may also need to contain the other attribute data, such as route, criticality, etc. for each undefined object.

The database and display system would eventually be updated to define this new requirement and the need for this portion of the chart file would then go away.

As an example, when the Terminal Arrival Area (TAA) was created in the United States, there was no database structure to support this feature at that time. Therefore there needed to be a means for the database supplier to provide TAA information for graphic depiction without requiring the display system to have any knowledge of what a TAA was.

5.2.2 Changes to Charting Specifications: Historically, changes have occurred to the charting specifications of chart producers based on industry input or other requirements. A key aspect of any charting system needs to be the ability to respond to these changes in a timely fashion. Similar to the description for undefined objects, a means should be provided to allow defining these changes in the chart file, until such time as the display system can be updated to be in compliance.

5.3 Display Generation:

The display system would use the information in the chart file to render the electronic chart per the guidelines in this document. This includes the specifics of display group locations, symbology, phase of flight transition logic, decluttering algorithms and system controls.

5.4 Charting Specifications:

In the interest of consistency and to minimize pilot retraining, electronic charting specifications should comply as closely as possible to existing paper charting specifications developed by governments, industry, and those in ICAO Annex 4-Aeronautical Charts. Deviations from existing specifications may be made to take into consideration the advantages and limitations of the electronic display.

6. NOTES:

6.1 Revision Indicator:

The change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document.

6.2 Key Words:

The following key words are provided to assist the capability of SAE Aerospace Technical Reports to be searched electronically.

Electronic Charts, Chart File, Aeronautical Charts, Electronic Display, NOTAMs, Declutter, Aeronautical Information, Human Factors, Moving Chart, Moving Map, Fixed Chart

PREPARED UNDER THE JURISDICTION OF
SAE SUBCOMMITTEE G-10J, AERONAUTICAL CHARTING OF
COMMITTEE G-10, AEROSPACE BEHAVIORAL ENGINEERING TECHNOLOGY (ABET)

APPENDIX A
ABBREVIATIONS AND ACRONYMS

When the following abbreviations and acronyms are used in this document, they have the following meanings:

ACARS	Aircraft communication addressing and reporting system
ADF	Automatic direction-finding equipment
ADIZ	Air defense identification zone
AIRAC	Aeronautical information regulation and control
ALT	Altitude
AMA	Area minimum altitude
APP	Approach
ARP	Airport reference point
ARPT	Airport
ARTCC	Air route traffic control center
ATC	Air traffic control
ATIS	Automatic terminal information service
AWY	Airway
BRG	Bearing
CAT	Category
CL	Center line
CNF	Computer navigation fix
COM	Communications
COTS	Commercial-off-the-shelf
COP	Change-over point
CRM	Crew resource management techniques
CRT	Cathode ray tube
CTR	Control zone
CWY	Clearway
D-ATIS	Digital automatic terminal information service
Db	Decibel
DME	Distance measuring equipment
DOT	Department of Transportation
DP	Departure procedure
EASA	European Aviation Safety Agency
EFB	Electronic flight bag
ELEV	Elevation
FAA	Federal Aviation Administration
FAF	Final approach fix
FIR	Flight information region
FL	Flight level
FMS	Flight management system

FREQ	Frequency
FSS	Flight service station
GBAS	Ground based augmentation system
GPS	Global positioning system
GS	Glideslope
GUI	Graphical user interface
HAA	Height above airport
HAT	Height above threshold
HDG	Heading
IAP	Instrument approach procedure
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ID	Identifier
IFR	Instrument flight rules
IHO	International Hydrographic Organization
ILS	Instrument landing system
IM	Inner marker
ISO	International Organization for Standardization
JAA	Joint Aviation Authorities
L	Left (runway identification)
LAAS	Local area augmentation system
LAT	Latitude
LONG	Longitude
MAA	Maximum authorized altitude
MAG	Magnetic
MAP	Missed approach point
MCA	Minimum crossing altitude
MDA	Minimum descent altitude
MDH	Minimum descent height
MEA	Minimum enroute altitude
MET	Meteorological
MM	Middle marker
MNM	Minimum
MNPS	Minimum navigation performance specifications
MOA	Military operating area
MOCA	Minimum obstruction clearance altitude
MORA	Minimum off-route altitude
MRA	Minimum reception altitude
MSA	Minimum sector altitude
MSL	Mean sea level

NASA	National Aeronautics and Space Administration
NOTAM	Notice to airmen
OM	Outer marker
OROCA	Off-route obstruction clearance altitude
PAPI	Precision approach path indicator
PDC	Pre-departure clearance
PFD	Primary flight display
PROC	Procedure
QFE	Atmospheric pressure at airport elevation (or at runway threshold)
QNH	Altimeter sub-scale setting to obtain elevation when on the ground
R	Right (runway identification)
RNAV	Area navigation
RNP	Required navigation performance
RTCA	RTCA, Inc, (formerly Radio Technical Commission for Aeronautics)
RVR	Runway visual range
RVSM	Reduced vertical separation minima
RWY	Runway
SAE	Society of Automotive Engineers
SBAS	Satellite based augmentation system
SID	Standard instrument departure
SMGCS	Surface movement guidance control system
STAR	Standard terminal arrival route
STAR (PANS-ABC)	Standard instrument arrival
TDZ	Touchdown zone
THR	Threshold
TMA	Terminal control area
TWIP	Terminal weather information for pilots
TWR	Airport control tower or airport control
TWY	Taxiway
UIR	Upper flight information region
VASI	Visual approach slope indicator
VFR	Visual flight rules
VNAV	Vertical navigation
VOR	VHF omni-directional radio range
VOT	VOR airborne equipment test facility
WAAS	Wide area augmentation system
WAC	World Aeronautical Chart 1:1,000,000
WPT	Waypoint

APPENDIX B
GLOSSARY

When the following terms are used in this document, they have the following meanings:

AIRCRAFT: Any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface. [ICAO Annex 6]

AIRPORT: A defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft. [ICAO Annex 14 (Aerodrome)]

AIRPORT ELEVATION: The elevation of the highest point of the landing area. [ICAO Annex 14 (Aerodrome elevation)]

ALERT: A visual auditory or tactile stimulus presented to attract the crew's attention and convey some information concerning an event/situation.

AIRPORT OPERATING MINIMA: The limits of usability of an airport for:

a) take-off, expressed in terms of runway visual range and/or visibility and, if necessary, cloud conditions;

b) landing in precision approach and landing operations, expressed in terms of visibility and/or runway visual range and decision altitude/height (DA/H) as appropriate to the category of the operation; and

c) landing in approach and landing operations with vertical guidance, expressed in terms of visibility and/or runway visual range and decision altitude/height (DA/H); and

d) landing in non-precision approach and landing operations, expressed in terms of visibility and/or runway visual range, minimum descent altitude/height (MDA/H) and, if necessary, cloud conditions. [ICAO Annex 6 (Aerodrome operating minima)]

AIRPORT REFERENCE POINT (ARP): The designated geographical location of an airport. [ICAO Annex 4 (Aerodrome reference point)]

AIRCRAFT STAND: A designated area on an apron intended to be used for parking an aircraft. [ICAO Annex 4]

AIR DEFENSE IDENTIFICATION ZONE (ADIZ): Special designated airspace of defined dimensions within which aircraft are required to comply with special identification and/or reporting procedures additional to those related to the provision of air traffic services (ATS). [ICAO Annex 4]

AIR TRAFFIC SERVICE: A generic term meaning variously, flight information service, alerting service, air traffic advisory service, air traffic control service (area control service, approach control service or airport control service). [ICAO Annex 4]

AIRWAY: A control area or portion thereof established in the form of a corridor. [ICAO Annex 4]

ALTITUDE: The vertical distance of a level, a point or an object considered as a point, measured from mean sea level (MSL). [ICAO Annex 4]

APRON: A defined area, on a land airport, intended to accommodate aircraft for purposes of loading or unloading passengers, mail or cargo, fuelling, parking or maintenance. [ICAO Annex 4]

AREA MINIMUM ALTITUDE (AMA): The lowest altitude to be used under instrument meteorological conditions (IMC) which will provide a minimum vertical clearance of 300 m (1000 ft) or in designated mountainous terrain 600 m (2000 ft) above all obstacles located in the area specified, rounded up to the nearest (next higher) 30 m (100 ft). [ICAO Annex 4]

ATTRIBUTE: Information in the chart file that describes the characteristics of a display element.

Note: For example, VOR attributes include frequency, Morse code, and class of navaid.

ATS ROUTE: A specified route designed for channeling the flow of traffic as necessary for the provision of air traffic services.

Note 1: The term ATS route is used to mean variously, airway, advisory route, controlled or uncontrolled route, arrival or departure route, etc.

Note 2: An ATS route is defined by route specifications which include an ATS route designator, the track to or from significant points (waypoints), distance between significant points, reporting requirements and, as determined by the appropriate ATS authority, the lowest safe altitude. [ICAO Annex 4]

AUTOMATIC TERMINAL INFORMATION SERVICE (ATIS): The automatic provision of current, routine information to arriving and departing aircraft throughout 24 hours or a specified portion thereof:

Digital-automatic terminal information service (D-ATIS): The provision of ATIS via datalink.

Voice-automatic terminal information service (Voice-ATIS): The provision of ATIS by means of continuous and repetitive voice broadcasts. [ICAO Annex 11]

BEARING: The horizontal direction to or from any point, usually measured clockwise from true north, magnetic north, or some other reference point through 360 degrees. [FAA Pilot/Controller Glossary]

CAUTION: Non-normal operational or aircraft system conditions that require crew awareness and may require future corrective crew action.

CHANGE-OVER POINT: The point at which an aircraft navigating on an ATS route segment defined by reference to very high frequency omnidirectional radio ranges is expected to transfer its primary navigational reference from the facility behind the aircraft to the next facility ahead of the aircraft.

Note: Change-over points are established to provide the optimum balance in respect of signal strength and quality between facilities at all levels to be used and to ensure a common source of azimuth guidance for all aircraft operating along the same portion of a route segment. [ICAO Annex 4]

CHART FILE: A file that defines each charted procedure and contains a listing of every chart specific element and associated attributes and rules.

CHART VIEW DECLUTTERING: The process of removing from the electronic chart display, by manual or automatic means, information elements that are not required at a particular time or for a given set of conditions. Chart view decluttering may be based on route information, equipage, chronology or information criticality.

CLEARWAY: A defined rectangular area on the ground or water under the control of the appropriate authority selected or prepared as a suitable area over which an aircraft may make a portion of its initial climb to a specified height. [ICAO Annex 4]

CLUTTER: A high information density on an electronic chart display that compromises the interpretability/legibility of display elements or the ability for flight crew to quickly identify and focus on high priority information.

COMPOSITION PARAMETERS: A set of programming instructions that specifies how a display element or set of elements may be portrayed on an electronic chart display.

Note: For example, composition parameters may define the range of possibilities for a display element's location, size, and priority. See also Display algorithms.

CONTOUR LINE: A line on a map or chart connecting points of equal elevation. [ICAO Annex 4]

CONTROL ZONE: A controlled airspace extending upwards from the surface of the earth to a specified upper limit. [ICAO Annex 11]

COORDINATES: The intersection of lines of reference, usually expressed in degrees/minutes/seconds of latitude and longitude, used to determine a position or location. [FAA Pilot/Controller Glossary]

COURSE:

1. The intended direction of flight in the horizontal plane measured in degrees from north.

2. The ILS localizer signal pattern usually specified as the front course or the back course.

3. The intended track along a straight, curved, or segmented MLS path. [FAA Pilot/Controller Glossary]

CRITICALITY: The importance of an item of information with respect to aircraft operation when using an electronic chart, based on functional need and not frequency of use.

CULTURE: All features constructed on the surface of the earth by man, such as cities, railways, canals, etc. [ICAO Annex 4]

DANGER AREA: An airspace of defined dimensions within which activities dangerous to the flight of aircraft may exist at specified times. [ICAO Annex 4]

DATA DRIVEN CHART: An electronic aeronautical chart that is dynamically created from a database of individual elements.

DECLUTTERING: See chart view decluttering.

DISPLACED THRESHOLD: A threshold not located at the extremity of a runway. [ICAO Annex 4]

DISPLAY ALGORITHMS: A set of programming instructions that render the display elements of an electronic chart onto the display medium within the limits set by composition parameters. These instructions may include the detection and resolution of visual conflicts between display elements.

DISPLAY ELEMENT: An individual item or features (aeronautical or topographical) which are included in a chart file for display on an electronic chart.

ELECTRONIC CHART: Very broad term to describe the data, the software, and the electronic system capable of displaying chart information. [International Hydrographic Organization Electronic Chart Display and Information System (ECDIS) Glossary]

ELEVATION: The vertical distance of a point or a level, on or affixed to the surface of the earth, measured from mean sea level. [ICAO Annex 4]

EQUIPAGE: Aircraft and/or ground equipment configuration and status.

FINAL APPROACH: That part of an instrument approach procedure which commences at the specified final approach fix or point, or where such a fix or point is not specified,

a) at the end of the last procedure turn, base turn or inbound turn of a racetrack procedure, if specified; or

b) at the point of interception of the last track specified in the approach procedure; and ends at a point in the vicinity of an airport from which:

   1) a landing can be made; or

   2) a missed approach procedure is initiated. [ICAO Annex 11]

FINAL APPROACH FIX OR POINT: That fix or point of an instrument approach procedure where the final approach segment commences. [ICAO Annex 4]

FINAL APPROACH SEGMENT: That segment of an instrument approach procedure in which alignment and descent for landing are accomplished. [ICAO Annex 4]

FIX: A fix is a generic name for a geographical position. A fix is referred to as a fix, waypoint, intersection, reporting point, etc. [RTCA SC-181/EUROCAE WG-13]

FIXED FULL CHART FORMAT: A static chart display, normally in a north up orientation and usually encompassing one procedure and one geographical area. The full chart format contains all information the issuing authority, procedure designer and chart designer determined was necessary for the pilot to completely understand the particular chart or procedure.

FIXED CHART FORMAT: The fixed full chart format display after decluttering.

FLIGHT CREW MEMBER: A licensed crew member charged with duties essential to the operation of an aircraft during a flight duty period. [ICAO Annex 6]

FLIGHT INFORMATION REGION: An airspace of defined dimensions within which flight information service and alerting service are provided. [ICAO Annex 11]

FLIGHT LEVEL: A surface of constant atmospheric pressure which is related to a specific pressure datum, 1 013.2 HectoPascals (hPa), and is separated from other such surfaces by specific pressure intervals.

Note 1: A pressure type altimeter calibrated in accordance with the Standard Atmosphere:

a) when set to a QNH altimeter setting, will indicate altitude;

b) when set to a QFE altimeter setting, will indicate height above the QFE reference datum;

c) when set to a pressure of 1 013.2 hPa, may be used to indicate flight levels.

Note 2: The terms "height" and "altitude", used in Note 1 above, indicate altimetric rather than geometric heights and altitudes. [ICAO Annex 11]

FLIGHT PLAN: Specified information provided to air traffic services units, relative to an intended flight or portion of a flight of an aircraft. [ICAO Annex 11]

GEOGRAPHY: An information group of auxiliary cartographic elements (e.g. grid, neat lines) and topographic elements that are generally not essential for instrument navigation.

GLIDE PATH: A descent profile determined for vertical guidance during a final approach. [ICAO Annex 4]

HEADING: The direction in which the longitudinal axis of an aircraft is pointed, usually expressed in degrees from North (true, magnetic, compass or grid). [ICAO PANS ATM]

HEIGHT: The vertical distance of a level, a point or an object considered as a point, measured from a specified datum. [ICAO Annex 4]

HOLDING PROCEDURE: A predetermined maneuver which keeps an aircraft within a specified airspace while awaiting further clearance. [ICAO Annex 4]

HYPSOMETRIC TINTS: A succession of shades or color gradations used to depict ranges of elevation. [ICAO Annex 4]

INSTRUMENT APPROACH PROCEDURE: A series of predetermined maneuvers by reference to flight instruments with specified protection from obstacles from the initial approach fix, or where applicable, from the beginning of a defined arrival route to a point from which a landing can be completed and thereafter, if a landing is not completed, to a position at which holding or en-route obstacle clearance criteria apply. [ICAO Annex 4]

ISOGONAL: A line on a map or chart on which all points have the same magnetic variation for a specified epoch. [ICAO Annex 4]

LANDING AREA: That part of a movement area intended for the landing or take-off of aircraft. [ICAO Annex 4]

LANDING DIRECTION INDICATOR: A device to indicate visually the direction currently designated for landing and for take-off. [ICAO Annex 4]

LAYER: A group of related information displayed as a whole. [IHO Electronic Chart Display and Information System (ECDIS) Glossary]

LEVEL: A generic term relating to the vertical position of an aircraft in flight and meaning variously, height, altitude or flight level. [ICAO Annex 11]

MAGNETIC VARIATION: The angular difference between True North and Magnetic North. [ICAO Annex 4]

Note: The value given indicates whether the angular difference is East or West of True North.

MILITARY OPERATIONS AREA: A military operations area (MOA) is airspace established outside Class A airspace to separate or segregate certain non-hazardous military activities from IFR traffic and to identify for VFR traffic where these activities are conducted. [FAA Pilot/Controller Glossary]

MINIMUM SECTOR ALTITUDE/MINIMUM SAFE ALTITUDE: The lowest altitude which may be used which will provide a minimum clearance of 300 m (1000 ft) above all objects located in an area contained within a sector of a circle of 46 km (25 nm) radius centered on a radio aid to navigation. [ICAO Annex 4]

MISSED APPROACH POINT (MAPt): That point in an instrument approach procedure at or before which the prescribed missed approach procedure must be initiated in order to ensure that the minimum obstacle clearance is not infringed. [ICAO Annex 4]

MISSED APPROACH PROCEDURE: The procedure to be followed if the approach cannot be continued. [ICAO Annex 4]

MOVING AIRCRAFT: An aircraft representation that moves relative to a stationary chart.

MOVING CHART FORMAT: A dynamic display of a chart, or series of charts, which change automatically in accordance with aircraft movement.

MOVING MAP: The map that moves relative to the aircraft position. The aircraft position may or may not be displayed on the moving map.

MOVEMENT AREA: That part of an airport to be used for the take-off, landing and taxiing of aircraft, consisting of the maneuvering area and the apron(s). [ICAO Annex 4]

MULTI-FUNCTIONAL DISPLAY: A device or system capable of displaying a variety of data, either simultaneously or sequentially on a single display unit.

NOTAM: A notice distributed by means of telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations. [ICAO Annex 15]

NON-DIRECTIONAL BEACON (NDB): A beacon that radiates a signal which provides directional guidance to and from the transmitting antenna. [FAA].

NON-PRECISION APPROACH PROCEDURE: A standard instrument approach procedure in which no electronic glide slope is provided. [FAA Pilot/Controller Glossary]

OBSTACLE: All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that are located on an area intended for the surface movement of aircraft or that extend above a defined surface intended to protect aircraft in flight.

Note: The term obstacle is used in this document solely for the purpose of specifying the display of objects which are considered a potential hazard to the safe passage of aircraft in the type of operation for which the displayed chart is designed. [developed from ICAO Annex 4]

PAN: To move an on-screen display window up, down, or laterally over a chart or image without changing the viewing scale. (See also Zoom)

PRECISION APPROACH PROCEDURE: An instrument approach procedure utilizing azimuth and glide path information provided by ILS or PAR. [ICAO Annex 4]

PROHIBITED AREA: An airspace of defined dimensions, above the land areas or territorial waters of a State, within which the flight of aircraft is prohibited. [ICAO Annex 4]

PROJECTION (CHART PROJECTION): A mathematical model, on which a chart is constructed, that transforms the locations of features on the earth's curved surface to locations on a two dimensional surface. Every chart projection distorts distance, area, shape, direction or some combination thereof. Principle aeronautical chart projections are Lambert Conformal Conic, Transverse Mercator and Polar Stereographic.

RADAR VECTORING: Provision of navigational guidance to aircraft in the form of specific headings, based on the use of radar. [ICAO Annex 4]

RANGE: The geographic extent of the displayed chart region (e.g. the distance covered by the displayed chart representation in either the vertical or horizontal direction). [Developed from RTCA Paper No. 103-00/SC181-117]

RELIEF: The inequalities in elevation of the surface of the earth represented on the aeronautical charts by contours, hypsometric tints, shading or spot elevations. [ICAO Annex 4]

REPORTING POINT: A specified geographical location in relation to which the position of an aircraft can be reported. [ICAO Annex 4]

REQUIRED NAVIGATION PERFORMANCE (RNP): A statement of the navigation performance necessary for operation within a defined airspace.

Note: Navigation performance and requirements are defined for a particular RNP type and/or application. [ICAO Annex 4]

RESTRICTED AREA: An airspace of defined dimensions, above the land areas or territorial waters of a State, within which the flight of aircraft is restricted in accordance with certain specified conditions. [ICAO Annex 4]

RUNWAY: A defined rectangular area on a land airport prepared for the landing and take-off of aircraft. [ICAO Annex 4]

RUNWAY-HOLDING POSITION: A designated position intended to protect a runway, an obstacle limitation surface, or an ILS/ MLS critical/sensitive area at which taxiing aircraft and vehicles shall stop and hold, unless otherwise authorized by the airport control tower. [ICAO Annex 4]

RUNWAY VISUAL RANGE (RVR): The range over which the pilot of an aircraft on the centerline of a runway can see the runway surface markings or the lights delineating the runway or identifying its centerline. [ICAO Annex 4] An instrumentally derived value that represents the horizontal distance a pilot will see down the runway. [TERPS]

SIGNIFICANT POINT: A specified geographical location used in defining an ATS route or the flight path of an aircraft and for other navigation and ATS purposes. [ICAO Annex 4]

STANDARD INSTRUMENT ARRIVAL/STANDARD TERMINAL ARRIVAL ROUTE (STAR): A designated instrument flight rule (IFR) arrival route linking a significant point, normally on an ATS route, with a point from which a published instrument approach procedure can be commenced. [ICAO PANS ATM]

STANDARD INSTRUMENT DEPARTURE (SID): A designated instrument flight rule (IFR) departure route linking the aerodrome or a specified runway of the aerodrome with a specified significant point, normally on a designated ATS route, at which the enroute phase of a flight commences. [ICAO PANS ATM]

STOPWAY: A defined rectangular area on the ground at the end of take-off run available prepared as a suitable area in which an aircraft can be stopped in the case of an abandoned take-off. [ICAO Annex 4]

TAXIING: Movement of an aircraft on the surface of an airport under its own power, excluding take-off and landing. [ICAO Annex 4]

TAXIWAY: A defined path on a land airport established for the taxiing of aircraft and intended to provide a link between one part of the airport and another, including:

a) Aircraft stand taxi lane. A portion of an apron designated as a taxiway and intended to provide access to aircraft stands only.

b) Apron taxiway. A portion of a taxiway system located on an apron and intended to provide a through taxi route across the apron.

c) Rapid exit taxiway. A taxiway connected to a runway at an acute angle and designed to allow landing aircraft to turn off at higher speeds than are achieved on other exit taxiways thereby minimizing runway occupancy times. [ICAO Annex 4]

THRESHOLD: The beginning of that portion of the runway usable for landing. [ICAO Annex 4]

TOUCHDOWN ZONE: The portion of a runway, beyond the threshold, where it is intended landing aeroplanes first contact the runway. [ICAO Annex 4]

TERMINAL CONTROL AREA: A control area normally established at the confluence of ATS routes in the vicinity of one or more major airports. [ICAO Annex 11]

TRACK: The projection on the earth's surface of the path of an aircraft, the direction of which path at any point is usually expressed in degrees from North (true, magnetic or grid). [ICAO Annex 4]

TRANSITION ALTITUDE: The altitude at or below which the vertical position of an aircraft is controlled by reference to altitudes. [ICAO Annex 4]

VISUAL APPROACH PROCEDURE: A series of predetermined manoeuvres by visual reference, from the initial approach fix, or where applicable, from the beginning of a defined arrival route to a point from which a landing can be completed and thereafter, if a landing is not completed, a go-around procedure can be carried-out. [ICAO Annex 4]

VISUAL CONFLICT: When the overlap or proximity of display elements degrade their individual interpretability/legibility.

VOR (VHF OMNIDIRECTIONAL RANGE): Radio aids available: VOR, VOR/DME, TACAN and VORTAC. The VOR provides for lateral sensing, while the VOR/DME includes Distance Measuring Equipment for determining distance from the station. TACAN or Tactical Air Navigation is used only by the military and requires special equipment to use. The VORTAC incorporates both VOR/DME and TACAN capabilities in one facility.

WARNING: Non-normal operation or aircraft system condition that requires immediate corrective or compensatory crew action after considering ensuring the continuation of required safe flight.

WAYPOINT: A specified geographical location used to define an area navigation route or the flight path of an aircraft employing area navigation. Waypoints are identified as either:

Fly-by waypoint: A waypoint which requires turn anticipation to allow tangential interception of the next segment of a route or procedure, or

Flyover waypoint: A waypoint at which a turn is initiated in order to join the next segment of a route or procedure. [ICAO Annex 4]

ZOOM: To display a larger or smaller region of an on-screen chart or image, keeping the graphics centered at the screen's center.

APPENDIX C
ELECTRONIC CHART DISPLAY GROUP LOCATIONS

A standard set of display information groups are defined in 4.3.1. The relative locations for these groups on an electronic chart display are then defined in 4.3.2. These location definitions draw from the historical placement of the same information groupings on a paper chart. Table C1 shows the locations used for the U.S. Government Charts, Jeppesen Charts and ICAO Standards. These were then used to decide on the recommended locations for the electronic charts.

TABLE C1 - Paper Chart Information Group Locations

Chart Source ——————— Information Group	U.S. Government	Jeppesen	ICAO
Heading	Top & Bottom - right margins	Spread across top	Top
Communications	2nd Row Down - Spread Across Top	2nd Row Down - Spread Across Top	Top Center
General Notes (not notes for specific locations on the charts)	3rd Row Down - Left Side	Bottom Of Briefing Strip	No Specific Location
Plan View	Middle	Middle	Middle
Profile View	Below Plan View	Below Plan View	Below Plan View
Missed Approach Text	3rd Row Down - Right Side	3rd Row Down Across Page	On Profile
Missed Approach Icons	Inside Profile View	Below Profile View	Volpe Icons Not Specified.
Landing Minimums	Bottom Left	Across Bottom	Bottom Left
Airport Sketch	Bottom Right Or Left	Not Applicable	Separate Chart

APPENDIX D
AERONAUTICAL INFORMATION CRITICALITY MATRICES

The matrices of this appendix (Tables D1 through D9 presented at the end of this appendix) are provided as guidelines for chart designer/database suppliers for the purpose of assigning criticalities to display elements in a chart file. While the data provided in these matrices is extensive, it does not necessarily represent a complete set of display elements for a given chart file, nor does any given chart file need to include all elements contained in a given matrix.

A matrix is provided for each of the following procedures or chart types. This listing, like the list of display elements in each matrix, is not necessarily a complete list of all chart types that may be contained in an electronic chart system, nor will every system contain all the listed chart types.

- Airport Charts
- Standard Instrument Departures (SIDs)
- Engine Out Procedures
- IFR Enroute
- Standard Terminal Arrival Routes (STARs)
- Instrument Approaches
- Charted Visual Approach Procedures
- Noise Abatement Procedures
- Visual Aeronautical Charts (VFR)

Matrix Development Background

The Aeronautical Information Matrices were developed by the Aeronautical Charting Subcommittee of the SAE G-10 Human Behavioral Technology Committee. The background presented here is significant to establish the work involved to bring the matrices to their current state.

The list of items for each matrix was developed by evaluating paper charts and listing the individual elements as completely as possible. Over time, items were added to each list of elements based on input from representatives of the different chart producers on the committee, research from government sources, including ICAO, and other inputs.

Once a list of display elements was generated, the committee members evaluated the criticality of each element for each phase of flight as described in this document. This required seven separate evaluations for each display element listed in each matrix. Once this was complete, an analysis was done to evaluate the differences between the various phases of flight for each chart type. The data showed that the criticality for any given item had meaningful differences in only two cases:

Matrix Development Background (Continued):

- When the chart is used for a flight crew briefing.
- When the chart is used for the tactical execution of the procedure.

Thus, the columns for each chart type were reduced to two, (except for approach charts which include a third column), as presented in this matrix.

The results of these evaluations have been compared to other research work done in the same or similar areas. In particular, the Volpe National Transportation Systems Center has done statistical studies on information depicted on airport diagrams, documented in two papers.

- Yeh, M. and Chandra, D. (2003) Air Transport Information Priorities for Surface Moving Maps. Proceedings of the 47th Annual Meeting of the Human Factors and Ergonomic Society: Santa Monica, CA

- Yeh, M. and Chandra, D. (2003). Determining minimal display element requirements for the surface map display. Proceedings of the 12th International Symposium on Aviation Psychology. Wright State University: Dayton, OH

The results of these studies generated ratings that are comparable with the concept of the matrices. The matrices have been modified to reflect as much as possible the testing that applied.

In an electronic aeronautical chart as described in this document, each item of information is evaluated individually. The information matrices provide a tabulation of the criticality for each item of information with respect to a particular chart or procedure.

Application of Matrix Content

The items in the information matrices do not reflect requirements for electronic chart file content. Rather, they are intended to provide guidance by assigning criticality levels for the chart designer/database supplier when creating an electronic chart file as described in Section 5.

Matrix Description

Each information matrix contains a set of columns as described below:

Matrix Column A - Categories and Items

Column A is a list of items that could be contained in any given electronic chart file. Information is grouped in the categories described below for organizational purposes only. The information categories in the matrices should not be confused with the display information groups described in 4.3.1.

- Identification - Information used to confirm that the required and current chart is being used. Current information is that known to be valid as of the date of publication.

- Geography - An information group of auxiliary cartographic elements (e.g., grid, neat lines) and topographic elements that are generally not essential for instrument navigation.

- Obstacle - An information group comprising the representation of natural features or man-made objects which have vertical significance in relation to adjacent and surrounding features and which are considered a potential hazard to the safe passage of aircraft in a particular type of operation/phase of flight.

- Minimum Area/Sector Altitudes - Established minimum altitudes for defined areas (e.g. based on a geographical grid) or sectors.

- Navigation - Navigation information that defines routes and procedures, and aeronautical information that is of associated importance. (e.g. course and navaid/fix information, airspace boundaries and relevant airport information)

- Navigation Aids - Information required for the identification and use of radio navigation facilities.

- Missed Approach - Information required for the identification and execution of missed approach procedures.

- Runway Information - Information concerning runways and associated stopways and clearways.

- Taxi information - Information facilitating ground movement on taxiways and aprons and the parking and docking of aircraft.

- Minimums (e.g., minimums for landing, takeoff, and alternates) - Visibility and altitude minimums information associated with approach, landing, takeoff, and alternate requirements.

- Communications - Communications information, including frequencies, communications boundaries and lost communications procedures, required for a particular type of operation/ phase of flight

Matrix Column B (Fixed Chart Format)

Column B represents the criticality of an item during the time that the flight crew is using the electronic chart display to brief the procedure. Column B criticalities are used to define what items may be deselected from the fixed chart format display (see 4.3.4.1).

Matrix Column C (Moving Aircraft or Moving Map)

Column C criticalities are applicable during the execution of a procedure when in the moving chart format. They are also applicable to the fixed chart format once the briefing is complete.

Matrix Column D (Missed Approach Moving Aircraft or Moving Map)

Instrument approach procedures have two distinct phases of flight that have different information requirements. Column D is applicable only to the execution of the missed approach phase of flight.

Criticality Column Applicability

The chart file for a procedure contains the criticality for each information item based on the information matrices columns in this appendix. While the organization of a chart file may differ from these matrices, Figure D1 presents a diagram that can be used to determine which matrix criticality column is applicable at any given time.
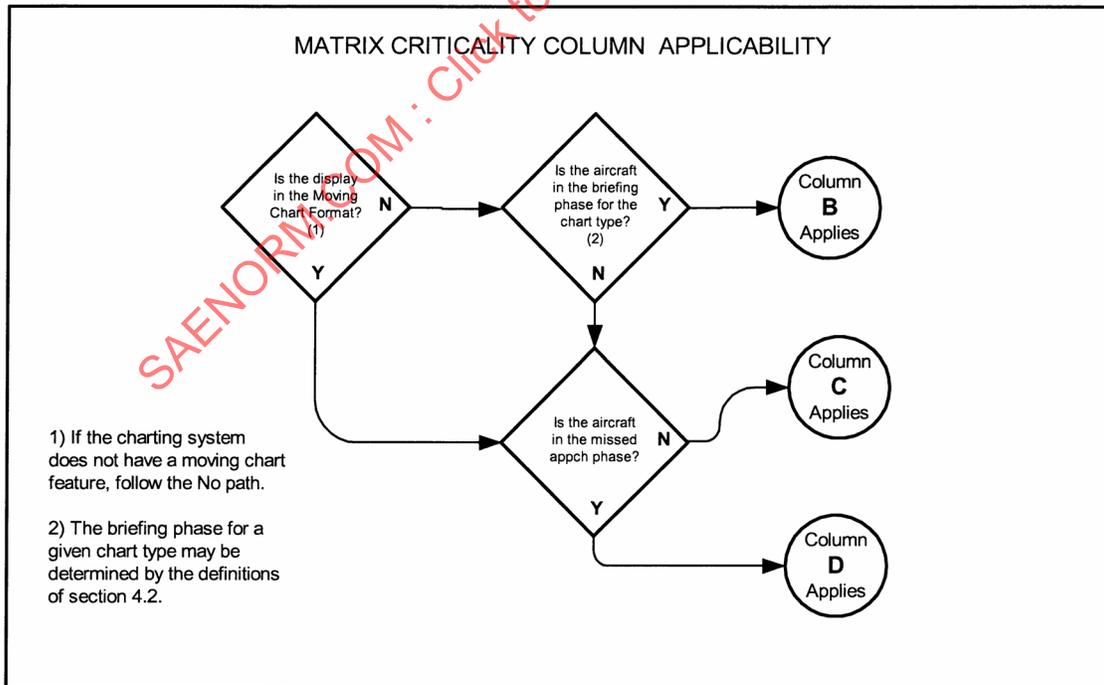
FIGURE D1 - Matrix Criticality Column Applicability

TABLE D1 - Airport Chart Criticality Matrix

Airport Charts		
A	**B**	**C**
Categories and Items **Identification**	**Fixed** **Chart Format** **Criticality**	**Moving Aircraft** **or Moving Map** **Criticality**
Revision Date	2	3
Chart Index Number	1	2
Effective Date	2	3
City/Location Name	2	2
Airport ICAO Identifier	1	1
Airport Name	1	1
Airport Elevation	1	1
Changes	2	3
Geography	**Criticality**	**Criticality**
Range	1	1
Neat Lines	2	3
Airport Reference Point (ARP)	2	3
ARP Latitude/Longitude	2	3
Latitude/Longitude Grid	2	3
Radial/DME from Airport (or closest VOR)	2	3
Magnetic Variation	2	3
Water Features	2	3
Roads	2	3
Terminal/Concourse / Gates	1	1
Other Buildings (OPS buildings, fire station, etc)	2	2
Restricted Areas	1	1
Parts of Movement Area identified unsuitable for aircraft	1	1
Boundaries of Air Traffic Control service	1	1
International Boundaries	2	3
Spot elevations	2	3
Control Tower	2	2
Airport Beacon	2	2
Obstacle	**Criticality**	**Criticality**
Obstacles	1	1
Runway Information	**Criticality**	**Criticality**
Runways/Numbers	1	1
Runway Magnetic Bearing	2	2
Length of Runway	1	1
Runway Landing Length (beyond glideslope)	2	2
Width of Runway	1	2
Runway Slope	2	3
Runway Elevation	2	1
Displaced Thresholds	1	1
Stopways/Clearways	1	1
Runway Surface Information (Grooving)	2	3

Airport Charts		
A	**B**	**C**
Categories and Items **Identification**	**Fixed Chart Format Criticality**	**Moving Aircraft or Moving Map Criticality**
Runway PCN	1	2
Runway Markings	1	2
Runway Lighting (CL, TDZ)	1	2
Runway Lighting (approach, PAPI/VASI w/angle)	2	2
Wind Direction Indicators	2	2
RVR Observation Sites	2	3
Taxi Information	**Criticality**	**Criticality**
Taxiways and letter designators	1	1
Taxiway Width	1	2
PCN when less than associated runway	2	3
Stop Bars	1	1
Runway Holding Positions	1	1
ILS Hold Lines	1	1
SMGCS (Surface Movement Guidance Control System)	2	2
Parking Stands including Coordinates	1	2
Quick Alignment (QA) fixes	2	2
Navigation	**Criticality**	**Criticality**
Preferred Taxiway Routes	2	2
Procedural Data Notes	1	1
VOT (including frequency)	2	3
Navigation Aids Shown on Airport Chart	2	3
Minimums	**Criticality**	**Criticality**
Take-off Minimums	2	2
Alternate Airport Minimums	2	2
Communications	**Criticality**	**Criticality**
ATIS Departure	2	2
ACARS - D-ATIS, PDC, TWIP	2	3
Clearance Delivery	2	3
Ground	2	2
Tower	2	2
Departure Control	2	2
Ramp Control	2	2

TABLE D2 - Standard Instrument Departure Chart Criticality Matrix

Standard Instrument Departures (SIDs) (Departures)		
A	**B**	**C**
Categories and Items **Identification**	**Fixed Chart Format Criticality**	**Moving Aircraft or Moving Map Criticality**
Revision Date	2	3
Chart Index Number/Page Number	1	3
Effective Date	2	3
City/Location Name	2	2
Airport Name	1	1
Airport ICAO Identifier	1	1
Procedure Name (e.g., Canoga Eight)	1	1
Procedure Identifier (e.g. CNOG8.VNY+A42)	2	2
DP Type (e.g. Pilot Nav, Vector, Noise, Obstacle)	1	2
Changes	2	3
Geography	**Criticality**	**Criticality**
Range	1	1
Neat Lines	2	3
Parallels and Meridians with AMAs, OROCAs, MORAs	2	2
Parallels and Meridians	2	3
Water Features	2	3
Cultural Features	2	3
Terrain Contours	2	2
Terrain Contour Elevations	2	2
Contour Interval Legend	2	3
Spot Elevations	2	2
Highest Reference Point (within neat lines)	2	2
International Boundaries (higher criticality where appropriate)	2	2
Obstacle	**Criticality**	**Criticality**
Obstacle Symbols and Elevation	2	3
Minimum Area / Sector Altitudes	**Criticality**	**Criticality**
MSA Reference Point/Center	2	2
MSA Distance when other than 25nm	2	2
MSA Sector Radials	2	2
MSA Minimum Altitudes	2	2
Minimum Radar Altitudes and Sectors	3	3
AMA, OROCA, or grid MORA where established	2	2
Navigation	**Criticality**	**Criticality**
FIR/UIR Boundaries	2	3
Prohibited, Restricted and Danger Airspace Graphic	1	1
Prohibited, Restricted and Danger Airspace Label	2	3
Prohibited, Restricted and Danger Airspace Narrative	2	3
Special Use Airspace - Other	2	2

Standard Instrument Departures (SIDs) (Departures)		
A	**B**	**C**
Categories and Items **Identification**	**Fixed** **Chart Format** **Criticality**	**Moving Aircraft** **or Moving Map** **Criticality**
Transition Altitude	1	2
Airport Information		
Runway Layout	1	1
Airport Elevation	1	1
Other Airport Symbols	2	2
Other Airport Names	2	2
Other Airport Elevations	2	2
Distances from airport to first fix on SID	2	3
Navaid used to form leg of procedure		
Symbol	1	1
Names	2	2
Identifier	1	1
Frequency/Channel	2	2
Morse Code	2	2
DME Availability (Text information)	2	3
Class	2	3
Latitude/Longitude	2	3
Navaids used to form fixes		
Symbol	1	1
Names	2	2
Identifier	1	1
Frequency/Channel	2	2
Morse Code	2	2
DME Availability (Text information)	2	3
Class	2	3
Latitude/Longitude	2	3
Navaid Radials/Bearings that form fixes	2	2
DME Distances that form fixes	1	2
Instrument Procedure Courses/tracks		
Symbol (line style, etc.)	1	1
Identifier (i.e., CNOG8.AVE)	1	1
Course Definition		
Heading	1	1
Track	1	1
Radial	1	1
Segment Mileages	2	2
MEA/MOCA	1	1
VOR Change Over Points	2	2
Holding Pattern		
Holding Pattern Depiction	1	1
Holding Pattern Courses	1	2
Holding Pattern Leg Length	1	2
Holding Pattern Time	1	2
Holding Pattern Speed	1	2
Holding Pattern Altitude	1	1
Transitions		

Standard Instrument Departures (SIDs) (Departures)		
A	**B**	**C**
Categories and Items **Identification**	**Fixed Chart Format Criticality**	**Moving Aircraft or Moving Map Criticality**
Transition Courses depiction	1	1
Transition Name	1	1
Transition Courses computer codes	1	2
Transition Course - Magnetic Values	1	1
Transition Courses - MEAs, MOCAs	2	2
Transition Courses - segment mileages	2	2
Transition Course notes (e.g. DME required)	1	2
Transition Text	1	1
Intersection/Fixes on Procedure		
Symbol	1	1
Names	2	2
Identifier	1	1
Latitude/Longitudes	2	3
MRA	2	3
Textual Information		
Runway departure text	1	1
Climb Gradient - ATC	1	1
Climb Gradient - Obstacle	1	1
Transition Text	2	3
Notes	2	2
Noise Abatement	2	2
Performance limitations (e. g., bank limits)	2	2
Text-Only Procedures	1	1
General Notes	2	2
Procedural Data Notes	2	2
Crossing Altitude Restrictions	1	1
Speed restrictions	1	1
Communications	**Criticality**	**Criticality**
Departure Control Frequency	2	2
Communications boundaries	2	2
Lost Comm Procedure	2	2
Lost Comm Procedure Outline Lines	2	2
Transponder Setting where appropriate	2	2

TABLE D3 - Engine Out Procedure Chart Criticality Matrix

Engine Out Procedures		
A	**B**	**C**
Categories and Items **Identification**	**Fixed Chart Format Criticality**	**Moving Aircraft or Moving Map Criticality**
Revision Date	2	3
Chart Index Number/Page Number	1	3
Effective Date	2	3
City/Location Name	2	2
Airport Name	1	1
Airport ICAO Identifier	1	1
Procedure Name	1	1
Procedure Identifier	2	2
Changes	2	3
Geography	**Criticality**	**Criticality**
Range	1	1
Neat Lines	2	3
Parallels and Meridians with AMAs, OROCAs, MORAs	2	2
Parallels and Meridians	2	3
Water features	2	3
Cultural Features	2	3
Terrain Contours	2	2
Terrain Contour Elevations	2	2
Contour Interval Legend	2	3
Spot Elevations	2	2
Highest Reference Point (within neat lines)	2	2
International Boundaries (higher criticality where appropriate)	2	2
Obstacle	**Criticality**	**Criticality**
Obstacle Symbols and Elevation	2	3
Minimum Area / Sector Altitudes	**Criticality**	**Criticality**
MSA Reference Point/Center	2	2
MSA Distance when other than 25nm	2	2
MSA Sector Radials	2	2
MSA Minimum Altitudes	2	2
Minimum Radar Altitudes and Sectors	3	3
AMA, OROCA, or grid MORA where established	2	2
Navigation	**Criticality**	**Criticality**
FIR/UIR Boundaries	2	3
Prohibited, Restricted and Danger Airspace Graphic	1	1
Prohibited, Restricted and Danger Airspace Label	2	3
Prohibited, Restricted and Danger Airspace Narrative	2	3
Special Use Airspace - Other	2	2
Transition Altitude	1	2

Engine Out Procedures		
A	**B**	**C**
Categories and Items **Identification**	**Fixed** **Chart Format** **Criticality**	**Moving Aircraft** **or Moving Map** **Criticality**
Airport Information		
Runway Layout	1	1
Airport Elevation	1	1
Other Airport Symbols	2	2
Other Airport Names	2	2
Other Airport Elevations	2	2
Navaid used to form leg of procedure		
Symbol	1	1
Names	2	2
Identifier	1	1
Frequency/Channel	2	2
Morse Code	2	2
DME Availability (Text information)	2	3
Class	2	3
Latitude/Longitude	2	3
Navaids used to form fixes		
Symbol	1	1
Names	2	2
Identifier	2	2
Frequency/Channel	2	2
Morse Code	2	3
DME Availability (Text information)	2	3
Class	2	3
Latitude/Longitude	2	3
Navaid Radials/Bearings that form fixes	2	2
DME Distances that form fixes	1	2
Instrument Procedure Courses/tracks		
Symbol (line style, etc.)	1	1
Identifier	1	1
Course Definition		
Heading	1	1
Track	1	1
Radial	2	1
Segment Mileages	2	2
MEA/MOCA	1	1
Holding Pattern		
Holding Pattern Depiction	1	1
Holding Pattern Courses	1	2
Holding Pattern Leg Length	1	2
Holding Pattern Time	1	2
Holding Pattern Speed	1	2
Holding Pattern Altitude	1	1
Intersection/Fixes on Procedure		
Symbol	1	1
Names	2	2
Identifier	1	1

Engine Out Procedures		
A	**B**	**C**
Categories and Items **Identification**	**Fixed Chart Format Criticality**	**Moving Aircraft or Moving Map Criticality**
Latitude/Longitudes	2	3
MRA	2	3
Textual Information		
Runway Departure Text	1	1
Climb Gradient - ATC	1	1
Climb Gradient - Obstacle	1	1
Transition Text	2	3
Notes	2	2
Noise Abatement	2	2
Performance Limitations (e. g., speed limits, bank limits)	2	2
Text-only Procedures	1	1
General Notes	2	2
Procedural Data Notes	2	2
Crossing altitude restrictions	1	1
Speed restrictions	1	1
Communications	**Criticality**	**Criticality**
Departure Control	2	2
Communications boundaries	2	2
Lost Comm Procedure	2	2
Lost Comm Procedure Outline Lines	2	2
Transponder Setting where appropriate	2	2

TABLE D4 - IFR Enroute Chart Criticality Matrix

IFR Enroute Charts		
A	**B**	**C**
Categories and Items **Identification**	**Fixed** **Chart Format** **Criticality**	**Moving Aircraft** **or Moving Map** **Criticality**
Revision Date (Start and Finish)	2	3
Chart Description (High, Low, etc.)	2	3
Geography	**Criticality**	**Criticality**
Range	1	1
Indication of Area Chart Coverage	2	3
Parallels and Meridians	1	1
Water Features	2	2
Terrain Contours	3	3
Terrain Contour Elevations	3	3
Contour Interval Legend	3	3
Spot Elevations	3	3
International Boundaries (higher criticality where appropriate)	2	2
Obstacle	**Criticality**	**Criticality**
Obstacle Symbols and Elevation (man made, exceptionally high)	3	3
Minimum Area / Sector Altitudes	**Criticality**	**Criticality**
Area Minimum Altitudes - OROCA Sector Altitudes (Grid MORA outside of US)	1	1
Navigation	**Criticality**	**Criticality**
Airspace Boundaries		
FIR/UIR Boundaries	1	1
Name of FIR/UIR	2	2
ID of FIR/UIR	1	2
FIR/UIR Vertical Limits	2	2
Unit Providing Service	2	2
Terminal Control Area (TMA) Boundaries	2	2
Name of TMA	2	2
TMA Vertical Limits	2	2
Unit Providing Area Control Service	2	2
Control Zone (CTR) Boundaries	2	2
Name of CTR	2	2
CTR Vertical Limits	2	2
Unit Providing Approach Control Service	2	2
Airspace Class Boundaries	2	2
Airspace Class Type	2	2
Airspace Class Name or Call Sign	2	2
Airspace Class Vertical Limits	2	2

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IFR Enroute Charts		
A	**B**	**C**
Categories and Items **Identification**	**Fixed Chart Format Criticality**	**Moving Aircraft or Moving Map Criticality**
Airspace Class Notes	2	2
Special Use Airspace - Prohibited, Restricted, Danger - Boundaries	1	2
Special Use Airspace ID and Vertical limits	1	2
Special Use Airspace - Other - Boundaries	1	2
Special Use Airspace ID and Vertical Limits	2	2
Air Defense Identification Zones (ADIZ)	1	1
Altimeter Setting Regions (lowest ALT for QNH)	2	2
Indication of Areas of RNP, RVSM, MNPS, etc Requirements	2	2
Time Zone Boundaries	2	3
Airways *(Note on the flight planned route items with * are level 1)*		
Airway Symbol (center line)	1	2*
Airway Designator	1	2*
Airway Magnetic Course	1	2*
Indication of one-way airways	1	2*
Times of one-way direction	1	2*
Segment Mileages	1	2*
Total Distance Between Navaids	2	2
Segment Upper Limit or MAA	1	2*
Segment Minimum Cruising Level or MEA	1	2*
Indication of MEA Change at Segment End	2	2
Segment MOCA	1	2*
Segment MORA	2	2*
Holding Patterns	2	2*
Holding Pattern restrictions	2	2*
VOR Change Over Point with Distances	2	2*
Intersection, Waypoint, or Fix Symbol	1	2*
Intersection, Waypoint, or Fix Name	2	2*
Intersection, Waypoint, or Fix ID of VOR, FREQ, MAG BRG	2	2*
Intersection, Waypoint, or Fix Distance from Reference DME	2	2*
Intersection, Waypoint, or Fix Coordinates	2	2
Indication of compulsory reporting	1	2*
Indication of MET Report Required	1	2*
Fix Formation bearing, frequency, ID of Remote Navaid	1	2*
Minimum Reception Altitude (MRA)	2	2*
Minimum Crossing Altitude (MCA)	2	2*
Computer Navigation Fix (CNF) and ID	2	2*
Transition Text	1	2*
Procedural Data Notes	1	2*
General Notes	1	2
Navigation Aids		
Navaid Symbol	1	1
Navaid Name	2	2*
Navaid Identifier	2	2*

IFR Enroute Charts		
A	**B**	**C**
Categories and Items **Identification**	**Fixed** **Chart Format** **Criticality**	**Moving Aircraft** **or Moving Map** **Criticality**
Navaid Frequency	2	2*
Navaid Coordinates	2	3
Navaid Morse Code	2	2
Navaid Class (e.g. H, T, and L)	2	3
Navaid Station Declination	3	3
DME Antenna Elevation	3	3
Indication of True North Navaids	2	2
Notes on Navaid Operational Status	1	2
Broadcast Stations or Marine Beacons	2	3
Airport Information		
Airport Symbol if for IFR use (includes suitable symbol type)	1	2
Airport Identifier if for IFR use	1	2
Airport Attributes if for IFR use	2	2
Airport Symbol if for VFR use (includes suitable symbol type)	2	3
Airport Identifier if for VFR use	2	3
Airport Attributes if for VFR use	2	3
Communications	**Criticality**	**Criticality**
Graphical Portrayal of Radio Frequency Sector Boundaries	2	2
Voice Frequencies associated with Navaid Facility Boxes	2	2
FIR/UIR, Control, ARTCC, etc. Frequency Boxes	2	2
Call and Frequencies of In-flight Weather Stations	2	2
Company Specific Frequencies (tailored communications)	2	2

TABLE D5 - Standard Terminal Arrival Route Chart Criticality Matrix

Standard Terminal Arrival Routes (STARs)		
A	**B**	**C**
Categories and Items **Identification**	**Fixed Chart Format Criticality**	**Moving Aircraft or Moving Map Criticality**
Revision Date	2	3
Chart Index Number/Page number	1	3
Effective Date	2	3
City/Location Name	2	2
Airport Name	1	1
Airport ICAO Identifier	1	1
Procedure Name (e.g., Canoga Eight)	1	1
Procedure Identifier (e.g. CNOG8.VNY)	2	2
Changes	2	3
Geography	**Criticality**	**Criticality**
Range	1	1
Neat Lines	2	3
Parallels and Meridians with AMAs, OROCAs, MORAs	2	2
Parallels and Meridians	2	3
Water Features	2	3
Cultural Features	2	3
Terrain Contours	2	2
Terrain Contour Elevations	2	2
Contour Interval Legend	2	3
Spot Elevations	2	2
Highest Reference Point (within neat lines)	2	2
International Boundaries (higher criticality where appropriate)	2	2
Obstacle	**Criticality**	**Criticality**
Obstacle Symbols and Elevation	2	3
Minimum Area / Sector Altitudes	**Criticality**	**Criticality**
MSA Reference Point/Center	2	2
MSA Distance when other than 25nm	2	2
MSA Sector Radials	2	2
MSA Minimum Altitudes	2	2
Minimum Radar Altitudes and Sectors	3	3
AMA, OROCA, or grid MORA where established	2	2
Navigation	**Criticality**	**Criticality**
FIR/UIR Boundaries	2	3
Prohibited, Restricted and Danger Airspace Graphic	1	1
Prohibited, Restricted and Danger Airspace Label	2	3
Prohibited, Restricted and Danger Airspace Narrative	2	3
Special Use Airspace - Other	2	2
Transition Level	1	2

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Standard Terminal Arrival Routes (STARs)		
A	B	C
Categories and Items Identification	Fixed Chart Format Criticality	Moving Aircraft or Moving Map Criticality
Airport Information		
Primary Airport Shaded Area	2	2
Primary Airport elevation	1	1
Primary Airport Runway Layout	1	1
Other Airport Symbols	2	2
Other Airport Names	2	2
Other Airport Elevations	2	3
Distances from last STAR fix to airport	2	3
Navaid used to form leg of procedure		
Symbol	1	1
Names	2	2
Identifier	1	1
Frequency/Channel	2	2
Morse Code	2	2
DME Availability (Text information)	2	3
Class	2	3
Latitude/Longitude	2	3
Navaids used to form fixes		
Symbol	1	1
Names	2	2
Identifier	1	1
Frequency/Channel	2	2
Morse Code	2	2
DME Availability (Text information)	2	3
Class	2	3
Latitude/Longitude	2	3
Navaid Radials/Bearings that form fixes	2	2
DME Distances that form fixes	1	2
Instrument Procedure Courses/tracks		
Symbol (line style, etc.)	1	1
Identifier (i.e., CNOG8.AVE)	1	1
Course Definition		
Heading	1	1
Track	1	1
Radial	2	1
Segment Mileages	1	1
MEA/MOCA	1	1
VOR Change Over Points	2	2
Holding Pattern		
Holding Pattern Depiction	1	1
Holding Pattern Courses	1	2
Holding Pattern Leg Length	1	2
Holding Pattern Time	1	2
Holding Pattern Speed	1	2
Holding Pattern Altitude	1	1

Standard Terminal Arrival Routes (STARs)		
A	**B**	**C**
Categories and Items **Identification**	**Fixed** **Chart Format** **Criticality**	**Moving Aircraft** **or Moving Map** **Criticality**
Transitions		
Transition Courses depiction	1	1
Transition Name	1	1
Transition Courses computer codes	1	2
Transition Course - Magnetic Values	1	1
Transition Courses - MEAs, MOCAs	2	2
Transition Courses - segment mileages	2	2
Transition Course notes (e.g. DME required)	1	2
Transition Text	1	1
Intersection/Fixes on Procedure		
Symbol	1	1
Names	2	2
Identifier	1	1
Latitude/Longitudes	2	3
MRA	2	3
Textual Information		
Runway arrival text	1	1
Transition Text	2	3
Notes	2	2
Noise Abatement	2	2
Performance limitations (e. g., bank limits)	2	2
Text-Only Procedures	1	1
General Notes	2	2
Procedural Data Notes	2	2
Crossing Altitude Restrictions	1	1
Speed restrictions	1	1
Communications	**Criticality**	**Criticality**
ATIS Arrival Frequency	2	2
ACARS - D-ATIS, TWIP	2	3
Approach Control (Arrival)	2	2
Communications Boundaries	2	2
Lost Comm Procedure	2	2
Lost Comm Procedure Outline Lines	2	2
Transponder Setting where appropriate	2	2

TABLE D6 - Instrument Approach Chart Criticality Matrix

Instrument Approach			
A	**B**	**C**	**D**
Categories and Items **Identification**	**Fixed Chart Format Criticality**	**Approach Moving Aircraft or Moving Map Criticality**	**Missed Moving Aircraft or Moving Map Criticality**
Revision Date	2	3	3
Chart Index Number/Page Number	1	3	3
Effective Date	2	3	3
City/Location Name	2	2	2
Airport Name	1	1	1
Airport ICAO Identifier	1	1	1
Procedure Name	1	1	1
Airport Elevation	1	1	1
Changes	2	3	3
Geography	**Criticality**	**Criticality**	**Criticality**
Range	1	1	1
Neat Lines	2	3	3
Parallels and Meridians	2	3	3
Magnetic Variation	2	3	3
Water Features	2	2	2
Cultural Features	2	3	3
Terrain Contours	2	2	2
Terrain Contour Elevations	2	2	2
Contour Interval Legend	2	3	3
Spot Elevations	2	2	2
Highest Reference Point (within neat lines)	2	2	2
International Boundaries (higher criticality where appropriate)	2	2	2
Visual Landmarks (when not reqd for navigation)	2	2	2
Visual Landmark Label (when not reqd for navigation)	2	2	2
Obstacle	**Criticality**	**Criticality**	**Criticality**
Obstacle Symbols and Elevation	2	2	2
Obstacle Heights and related datum	2	2	2
Minimum Area / Sector Altitudes	**Criticality**	**Criticality**	**Criticality**
MSA Reference Point/Center	2	2	2
MSA Distance when other than 25nm	2	2	2
MSA Sector Radials	2	2	2
MSA Minimum Altitudes	2	2	2
Minimum Radar Altitudes and Sectors	3	3	3
Runway Information	**Criticality**	**Criticality**	**Criticality**
Primary Airport			
Runway Layouts	1	1	1

Instrument Approach			
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Categories and Items Identification	Fixed Chart Format Criticality	Approach Moving Aircraft or Moving Map Criticality	Missed Moving Aircraft or Moving Map Criticality
Landing Runway Number	1	1	3
Other Runway Numbers	2	3	3
Straight-in Landing Runway Length	2	3	3
TDZE/Threshold Elevation for Landing Runway	1	1	3
Glide Path Intercept Point	2	3	3
Runway Location in Profile View	1	1	1
Secondary Airports			
Source Doc-Runway Layouts & Name	2	2	2
IFR Airports in Plan View	2	2	3
VFR Apts. within Spec Dist. App Track	2	2	3
Navigation	**Criticality**	**Criticality**	**Criticality**
FIR/UIR Boundaries	2	3	3
Terminal Arrival Area (TAA)	2	2	2
Prohibited, Restricted and Danger Airspace Graphic	1	1	1
Prohibited, Restricted and Danger Airspace Label	2	3	3
Prohibited, Restricted and Danger Airspace Narrative	2	3	3
Special Use Airspace - Other	2	2	2
General Notes	1	2	2
Procedural Data Notes	1	2	2
Transition Level	1	2	3
Transition Altitude	1	2	3
Fix Symbol	1	1	1
Fix Name/Identifier	1	1	1
Fix Altitude	1	1	1
Step-Down Fix Altitude	1	1	3
Step-Down Fix Formation	1	1	3
Fix Formation	1	1	1
All appropriate navaid symbols	1	1	1
Procedure Track	1	1	1
Procedure Mag. Course	1	1	1
Procedure Track Altitude	1	1	2
Procedure Track Mileage	1	1	2
Procedure Turn Outbound Course	1	1	2
Procedure Turn Altitude	1	1	2
Procedure Turn Distance Limit	1	1	2
Lead Radial	1	1	3
Localizer Magnetic Course	1	1	1
FAF (Maltese cross)	1	1	1
FAF Crossing Altitude (MSL) (HAT)	1	1	3
GS Intercept Altitude (MSL)	1	1	3
GS Intercept Altitude (Above Arpt) (QFE)	1	1	3
Glide Slope Angle	2	2	3
VNAV Intercept Altitude (MSL)	1	1	3
VNAV Intercept Altitude (Above Arpt) (QFE)	1	1	3

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Instrument Approach			
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Categories and Items **Identification**	**Fixed Chart Format Criticality**	**Approach Moving Aircraft or Moving Map Criticality**	**Missed Moving Aircraft or Moving Map Criticality**
VNAV Angle	2	2	3
Rate of Descent (feet per minute)	2	2	3
Threshold Crossing Height	2	2	3
Navigation Aids	**Criticality**	**Criticality**	**Criticality**
Localizer Frequency	1	1	1
Localizer Identifier	2	2	2
Localizer Morse Code	2	2	2
Primary Approach Localizer Symbol	1	1	1
Simultaneous Parallel Loc Symbol	2	2	2
Localizer for Intersection Formations	1	1	1
Localizer Front Course for Back Crs Apprchs	1	1	1
WAAS/SBAS - LAAS/GBAS Channel	1	1	2
Marker Beacon Symbols	1	1	1
Marker Beacon Labels (OM,MM,IM)	1	1	1
Procedure Navaid			
Symbol	1	1	1
Names	2	2	2
Identifier	1	1	1
Frequencies	2	2	2
Morse Code	2	3	3
DME Availability	2	3	3
Class	2	3	3
Latitude/Longitude of navaid	3	3	3
Navaids in the vicinity of the procedure			
Symbol	2	2	2
Names	2	2	2
Identifier	2	2	2
Frequencies	2	2	2
Morse Code	2	3	3
DME Availability	2	3	3
Class	3	3	3
Latitude/Longitude of navaid	3	3	3
Landing Minimums	**Criticality**	**Criticality**	**Criticality**
Minimum Descent Altitude (MDA)	1	1	3
Minimum Descent Height (MDH)	2	2	3
Height Above Airport (HAA)	2	2	3
CAT I Decision Altitude (DA)	1	1	3
CAT II Decision Altitude (DA)	2	2	3
Decision Height (DH)	2	2	3
CAT II Radio Altimeter (RA)	1	1	3
Visibility Requirement	1	1	3

Instrument Approach			
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Missed Approach	**Criticality**	**Criticality**	**Criticality**
Missed Approach Instructions	2	3	1
Name of Missed App Holding Fix	2	3	1
Missed App Holding Pattern	2	3	1
Location of MAP	1	1	1
Time From FAF to MAP	2	1	3
Distance From FAF to MAP	2	1	3
Fix Name/Identifier at MAP	1	1	1
Holding Pattern	**Criticality**	**Criticality**	**Criticality**
Holding Pattern Depiction	1	1	1
Holding Pattern Courses	1	2	2
Holding Pattern Leg Length	1	2	2
Holding Pattern Time	1	2	2
Holding Pattern Speed	1	2	2
Holding Pattern Altitude	1	1	1
Communications	**Criticality**	**Criticality**	**Criticality**
ATIS Arrival Frequency	2	3	3
Departure Control Frequency	2	3	3
Tower Frequency	2	1	2
Ground Frequency	2	2	3
Approach Frequency	2	2	2
Clearance Frequency	2	3	3
ATIS Departure Frequency	2	3	3
Helicopter Frequency	2	1	2