# Survey of Symbology for Aeronautical Charts and Electronic Displays: Navigation Aids, Airports, Lines, and Linear Patterns

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This industry survey documents the symbols for navigation aids, airports, lines, and linear patterns currently in use by avionics manufacturers and chart providers for depicting aeronautical charting information. Nine avionics display manufacturers and four chart providers participated. The information provided by avionics manufacturers is shown only on electronic displays whereas the information from chart providers is shown on paper charts and may also be shown on electronic displays.

The first section of this report provides background information, including Federal Aviation Administration (FAA) guidance regarding symbology, considerations for manufacturers for designing and testing symbology, and an overview of Volpe Center research addressing aeronautical charting symbology. The next three sections contain tables that show navigation aid symbols, airport symbols, and lines and linear patterns. A list of reference documents, including policy and research documents, is included at the end of this report.

This document is intended to be used by the FAA. Avionics manufacturers and chart providers may also find this document informative.

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# PREFACE

This report was prepared by the Human Factors Division of the Office of Aviation Programs at the Volpe National Transportation Systems Center. It was completed with funding from the Federal Aviation Administration (FAA) Human Factors Research and Engineering Group (AJP-61) in support of the Aircraft Certification Service Avionics Branch (AIR-130) and the Technical Programs and Continued Airworthiness Branch (AIR-120). We would like to thank our FAA program manager, Tom McCloy, as well as our technical sponsor Colleen Donovan for providing suggestions and feedback. Many thanks go to the manufacturers who generously donated their time to provide their symbols, lines, and linear patterns for this report. We would also like to thank Andrew Kendra at the Volpe Center, who helped collect the information, and the members of the SAE International G-10 Aeronautical Charting Committee, who provided feedback on this document.

The views expressed herein are those of the authors and do not necessarily reflect the views of the John A. Volpe National Transportation Systems Center, the Research and Innovative Technology Administration, or the United States Department of Transportation.

Feedback on this document may be sent to Michelle Yeh (Michelle.Yeh@dot.gov) or Divya Chandra (Divya.Chandra@dot.gov). Further information on this research effort can be found at http://www.volpe.dot.gov/hf.

## METRIC/ENGLISH CONVERSION FACTORS

| ENGLISH TO METRIC | METRIC TO ENGLISH |
|---|---|
| **LENGTH (APPROXIMATE)** | **LENGTH (APPROXIMATE)** |
| 1 inch (in) = 2.5 centimeters (cm) | 1 millimeter (mm) = 0.04 inch (in) |
| 1 foot (ft) = 30 centimeters (cm) | 1 centimeter (cm) = 0.4 inch (in) |
| 1 yard (yd) = 0.9 meter (m) | 1 meter (m) = 3.3 feet (ft) |
| 1 mile (mi) = 1.6 kilometers (km) | 1 meter (m) = 1.1 yards (yd) |
| | 1 kilometer (km) = 0.6 mile (mi) |
| **AREA (APPROXIMATE)** | **AREA (APPROXIMATE)** |
| 1 square inch (sq in, $in^2$) = 6.5 square centimeters ($cm^2$) | 1 square centimeter ($cm^2$) = 0.16 square inch (sq in, $in^2$) |
| 1 square foot (sq ft, $ft^2$) = 0.09 square meter ($m^2$) | 1 square meter ($m^2$) = 1.2 square yards (sq yd, $yd^2$) |
| 1 square yard (sq yd, $yd^2$) = 0.8 square meter ($m^2$) | 1 square kilometer ($km^2$) = 0.4 square mile (sq mi, $mi^2$) |
| 1 square mile (sq mi, $mi^2$) = 2.6 square kilometers ($km^2$) | 10,000 square meters ($m^2$) = 1 hectare (ha) = 2.5 acres |
| 1 acre = 0.4 hectare (he) = 4,000 square meters ($m^2$) | |
| **MASS - WEIGHT (APPROXIMATE)** | **MASS - WEIGHT (APPROXIMATE)** |
| 1 ounce (oz) = 28 grams (gm) | 1 gram (gm) = 0.036 ounce (oz) |
| 1 pound (lb) = 0.45 kilogram (kg) | 1 kilogram (kg) = 2.2 pounds (lb) |
| 1 short ton = 2,000 pounds (lb) = 0.9 tonne (t) | 1 tonne (t) = 1,000 kilograms (kg) = 1.1 short tons |
| **VOLUME (APPROXIMATE)** | **VOLUME (APPROXIMATE)** |
| 1 teaspoon (tsp) = 5 milliliters (ml) | 1 milliliter (ml) = 0.03 fluid ounce (fl oz) |
| 1 tablespoon (tbsp) = 15 milliliters (ml) | 1 liter (l) = 2.1 pints (pt) |
| 1 fluid ounce (fl oz) = 30 milliliters (ml) | 1 liter (l) = 1.06 quarts (qt) |
| 1 cup (c) = 0.24 liter (l) | 1 liter (l) = 0.26 gallon (gal) |
| 1 pint (pt) = 0.47 liter (l) | |
| 1 quart (qt) = 0.96 liter (l) | |
| 1 gallon (gal) = 3.8 liters (l) | |
| 1 cubic foot (cu ft, $ft^3$) = 0.03 cubic meter ($m^3$) | 1 cubic meter ($m^3$) = 36 cubic feet (cu ft, $ft^3$) |
| 1 cubic yard (cu yd, $yd^3$) = 0.76 cubic meter ($m^3$) | 1 cubic meter ($m^3$) = 1.3 cubic yards (cu yd, $yd^3$) |
| **TEMPERATURE (EXACT)** | **TEMPERATURE (EXACT)** |
| [(x-32)(5/9)] °F = y °C | [(9/5) y + 32] °C = x °F |

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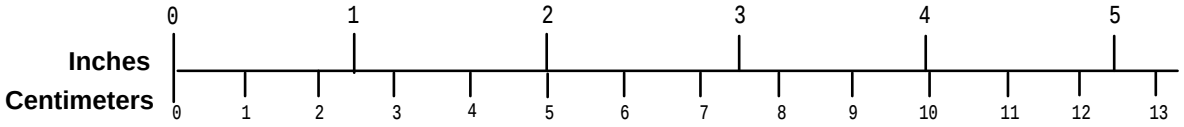
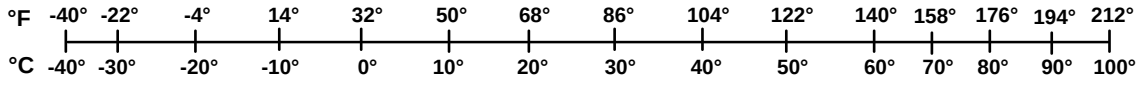



## QUICK FAHRENHEIT - CELSIUS TEMPERATURE CONVERSION

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# Executive Summary

This industry survey documents the symbols, lines, and linear patterns currently in use for depicting aeronautical charting information. It is intended to provide a snapshot of the current state of chart and electronic display symbology only; it does not serve as an endorsement of the symbols, lines, and linear patterns included here.

Nine avionics manufacturers and four chart providers participated. The information provided by avionics manufacturers is shown only on electronic displays whereas the information from chart providers is shown on paper charts and may also be shown on electronic displays. Guidance from the Federal Aviation Administration (FAA) regarding symbology, considerations for manufacturers for designing and testing symbology, and an overview of research conducted by the John A. Volpe National Transportation Systems Center (Volpe Center) addressing aeronautical charting symbology is also included.

This document contributes to an effort by the Volpe Center to support the FAA in developing recommendations for aeronautical charting information on electronic displays. Avionics manufacturers and chart providers may also find this document informative.

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# Acronyms

| | |
|---|---|
| AC | Advisory Circular |
| ADIZ | Air Defense Identification Zone |
| ARP | Aerospace Recommended Practice |
| ARSA | Airport Radar Service Area |
| ARTCC | Air Route Traffic Control Center |
| ATM | Air Transportation Management |
| ATZ | Air Traffic Zone |
| CTA/CTL | Control Area |
| CTZ/CTR | Control Zone |
| CNS | Communications Navigations and Surveillance |
| DME | Distance Measuring Equipment |
| EASA | European Aviation Safety Agency (EASA) |
| EFB | Electronic Flight Bag |
| EMD | Electronic Map Display |
| FAA | Federal Aviation Administration |
| FIR | Flight Information Region |
| FMS | Flight Management System |
| HPZ | Helicopter Protected Zone |
| HTZ | Helicopter Traffic Zone |
| ICAO | International Civil Aviation Organization |
| ILS | Instrument Landing System |
| IFR | Instrument Flight Rules |
| LOM | Compass Locator at the Outer Marker |
| MCTR | Military Control Zone |
| MATZ | Military Air Traffic Zone |
| NACO | National Aeronautical Charting Office |
| NDB | Non-Directional Beacon |
| OCA | Oceanic Control Area |
| PCA | Positive Control Area |
| QFE/QNH | Altimeter Setting Regions |
| RNAV | Area Navigation |
| SID | Standard Instrument Departure |
| STAR | Standard Arrival Route |
| STZ | Special Rules Area/Zone |
| SUA | Special Use Airspace |
| TACAN | Tactical Air Navigation |
| TCA/TMA | Terminal Control Area |
| TIA | Traffic Information Area/Zone |

| | |
|---|---|
| TFR | Temporary Flight Restriction Area |
| TRSA | Terminal Radar Service Area |
| TSO | Technical Standard Order |
| UCA/UTA | Upper Control Area |
| UFIR | Upper Flight Information Region |
| US | United States |
| VFR | Visual Flight Rules |
| VOR | VHF OmniRange Navigation System |
| VORDME | VHF Omni-Directional Radio/Distance-Measuring Equipment |
| VORTAC | VHF Omni Range Radio/Tactical Air Navigation |

# 1 Introduction

The John A. Volpe National Transportation Systems Center (Volpe Center) is supporting the Federal Aviation Administration (FAA) to develop recommendations for the depiction of symbols, lines, and linear patterns on electronic displays of charting information with the goal of promoting safety and consistency. Aeronautical charting information is shown on paper charts and on many electronic flight deck displays as well. The lack of consistency across these products is of concern because pilots may use charting information from more than one source during a given operation. The use of different symbols has proliferated; it is possible to find one symbol used by different manufacturers to depict different information, as well as different symbols used to represent the same element.

There is currently no comprehensive set of recommended symbols, lines, and linear patterns for the electronic display of charting information, although several documents provide recommendations and guidelines for limited sub-sets (e.g., International Civil Aviation Organization (ICAO) *Annex 4, Aeronautical Charts* [6], and RTCA DO-257A, *Minimum Operational Performance Standards for the Depiction of Navigational Information on Electronic Maps* [10]). A list of symbols, lines, and linear patterns used by avionics manufacturers and chart providers was included in SAE Aerospace Recommended Practices (ARP) 5289, *Electronic Aeronautical Symbols* [12], along with a set of recommendations. The original ARP 5289 was issued in 1997, but an updated version is expected to be completed in 2009. ARP 5289 is being updated by the SAE International Aerospace Behavioral Engineering and Technology (G-10) Aeronautical Charting Committee because some of the recommended symbols were not in widespread use. Upon review, it was determined that some of the recommended symbols could not be properly depicted in an electronic format for various reasons (e.g., too much detail for depiction on smaller, older displays). Consequently, there has been a proliferation of alternative symbols (e.g., multiple versions of NDBs, etc.) in the past several years.

The revised ARP 5289 will provide a comprehensive set of recommended symbols, lines, and linear patterns for depiction on electronic displays. However, the revised ARP will no longer contain tables showing what is currently depicted on electronic and paper products. As a result, the FAA requested that the Volpe Center collect the symbols, lines, and linear patterns used on electronic charts and map displays separately, in an effort to document what has been previously approved and is currently in use. This industry survey is intended to be used by the FAA; avionics manufactures and chart providers may also find it informative.

This industry survey contains navigation aid symbols, airport symbols, and lines and linear patterns. The term *line* refers to an element typically used to denote a boundary. Lines vary from one another in terms of width (e.g., thick or thin) and/or style (e.g., dotted, dashed, bold). A *linear pattern* may also be used to denote a boundary, but it is represented by a set of repeated patterns or symbols (e.g., several x's along a row). Lines and linear patterns were collected for six categories of information: routes/flight tracks, airspaces, areas/regions, zones, geographical features, and other. In order to collect this information, the Volpe Center sent a request for participation to avionics manufacturers and chart providers that contained a comprehensive list of symbols, lines, and linear patterns. Participants were asked to indicate what was shown on their products, and to provide the Volpe Center with an electronic image of the display element currently used for inclusion in a table similar to that in SAE ARP 5289 [12].

Nine avionics display manufacturers and four chart providers participated. The information provided by avionics manufacturers is shown only on electronic displays whereas the information from chart providers is shown on paper and may also be shown on electronic displays. The avionics display manufacturers were Airbus, Avidyne, Boeing, Garmin, Honeywell, L-3 Communications, Rockwell Collins, Smiths, and Universal. The chart providers were ICAO, the FAA/National Aeronautical Charting Office (NACO), Jeppesen, and Lido. Although ICAO is not a chart manufacturer, its recommendations are recognized as standards for its member states, which do produce charts. Note also that symbols, lines, and linear patterns used by chart providers may be displayed on both paper and electronic mediums. ICAO provides different specifications for some navigation aid symbols depending on whether the symbols are shown on

paper or electronically (both symbols are included in this document), but others do not. Jeppesen and Lido produce charts both in paper and electronic formats, and the information is depicted in the same way for both mediums. NACO charts and symbology are publicly available, and are used on electronic displays by third-party manufacturers.

This report is divided into four sections. The first section provides background information. It reviews FAA guidance regarding symbology, lists considerations for manufacturers for designing and testing symbology, and provides an overview of Volpe Center research addressing symbology. The next three sections show tables for navigation aid symbols, airport symbols, and lines and linear patterns currently in use. The tables distinguish between information shown on electronic displays and information shown on charts. The tables are intended only to provide a snapshot of the current state of chart and electronic display symbology. They do not serve as an endorsement of the symbols, lines, and linear patterns shown. Note that not all of the symbols, lines, and linear patterns listed here are depicted by all the manufacturers who participated in the industry survey. If an element is not depicted, then “Not Depicted” is indicated in the table. Manufacturer notes regarding their symbology are provided in Appendix A.

A complete alphabetical index of symbols, lines, and linear patterns in this survey is listed at the end of this document. Links to manufacturer websites and references to policy and research documents are also provided.

# 2 Considerations for Designing and Evaluating Symbology

This section provides excerpts from published requirements and guidance on the use of symbology, considerations for evaluating new symbology, and an overview of Volpe Center research addressing symbology. The information in this section may be applicable when evaluating existing symbols, lines, and linear patterns when new technology or displays are introduced or when it is determined that current symbols, lines, and linear patterns are not sufficient. Much of the guidance and considerations address the display of symbols rather than lines and linear patterns. However, because linear patterns may be composed of repeating symbols, the information in this section may be relevant to their design and evaluation as well.

## *2.1 FAA Requirements and Guidance*

The following guidance on the selection and presentation of symbology was extracted from FAA Advisory Circulars (AC), Technical Standard Orders (TSOs), and independent documents referenced in TSOs and ACs (e.g., RTCA and SAE documents). The source document is provided in brackets immediately following each item. Some requirements and recommendations have multiple references. In these cases, editorial changes to the wording in the source documents may have been made in order to consolidate similar requirements. Additionally, system specific words or acronyms were removed to help the reader better understand the general issue.

The words "shall," "must," or "should" appear in most of the requirements and guidance items below. These words were retained from the original source documents. These terms are typically used in ACs and TSOs or documents that they invoke (e.g., RTCA documents). The term "shall" is used to indicate a minimum requirement, "must" is a requirement typically required by regulation, and "should" indicates a strong recommendation.

<u>Symbol Discriminability and Distinctiveness</u>

- Symbols shall be distinctive and discriminable from one another. [RTCA DO-229D, 2.2.1.1.4.1; see also AC 25-11A]
- All displayed information such as symbols, graphics, and alphanumeric characters should be clearly differentiated from one another and legible under all ambient illumination conditions. [AC 23.1311-1B, 16.1]
- The potential for misinterpreting symbols should be minimized. [RTCA DO-229D, 2.2.1.1.4.4]
- To minimize confusion or misinterpretation, symbols should be easy to discern, consistent within the cockpit, and learned with minimal training. Symbols should not have shapes, colors, or other attributes that are ambiguous or could be confused with the meaning of similar symbols. [AC 23.1311-1B, 17.1]
- Symbols shall be discriminable at a nominal viewing distance of 29", a minimum viewing distance of 10", and a maximum viewing distance of 50" under all flight deck lighting conditions. [SAE AIR 1093; see also RTCA DO-256 2.1.3.1]
- The display shall show distinctive symbols for different fix types (waypoints, airports, VORs, NDBs, intersections) and the aircraft (ownship). [TSO C-165/RTCA DO-257A, 2.2.1.1]

  <u>Notes</u>:

  1. These symbols make up the minimum required symbol set.
  2. If the input to the display does not distinguish between flight plan fix types (e.g., VOR vs. NDB), then the waypoint symbol is acceptable. However, if off-route fixes (e.g., VORs) are displayed, they must use the distinctive symbols appropriate for the fix type.

- New symbols (a new design or a new symbol for a function which historically had an associated symbol) should be tested for flight crew comprehension, distinguishability, and retention. [HF-HWG Final Report, 7.4.2(e)]

Symbol Consistency with Paper Charts, Other Avionics, and Aviation Industry Standards

- Electronic displays in the cockpit should use symbology consistent with their intended function. [AC 23.1311-1B, 17.1]
- Displays should use characteristics and symbols similar to those shown on published charts and sectionals or with commonly accepted aviation practices. [RTCA DO-229D, 2.2.1.1.4.4; TSO C-165/RTCA DO-257A, 2.2.1.1]

Symbols Used For Only One Purpose

- Within the flight deck, avoid using the same symbol for different purposes, unless it can be shown that there is no potential for misinterpretation errors or increases in flightcrew training times. [AC 25-11A, 31.c.(3)(b)]
- The shape, dynamics, and other symbol characteristics representing the same function on more than one display on the same flight deck should be consistent. [AC 25-11A, 31.c.(3)(a)]
- Symbols representing the same functions on more than one display should be the same. Different symbols among different displays for the same functions may be acceptable only if it can be clearly shown that the pilot can quickly and consistently recognize, interpret, and respond correctly without incurring excessive pilot workload. [AC 23.1311-1B, 17.1]
- Symbols shall be used for a single purpose within the system. [RTCA DO-256, 2.1.3.1]
- Symbols used for one purpose on published charts should not be used for another purpose on the equipment display. [RTCA DO-229D, 2.2.1.1.4.4; TSO C-165/RTCA DO-257A, 2.2.1.1]

Symbol Orientation

- All symbols shall be depicted in an upright orientation except for those designed to reflect a particular compass orientation.

  NOTE: This requirement does not apply to Raster Aeronautical Charts (RAC) data because it may not be able to meet this requirement due to the fundamental nature of that data. It does apply to vector data superimposed onto a Raster Chart. [TSO C-165/RTCA DO-257A, 2.2.1.1]
- Symbols indicating a particular compass orientation shall maintain that compass orientation at all times. An example of this is a depiction of a runway symbol that maintains proper compass orientation as the map rotates. [TSO C-165/RTCA DO-257A, 2.2.1.1]
- If heading or track is available, the aircraft/ownship symbol shall be directional, oriented to either heading or track. [TSO C-165/RTCA DO-257A, 2.2.1.1]
- If the system supports more than one aircraft symbol directional orientation (e.g., heading and track), then the current aircraft symbol orientation shall be indicated. [TSO C-165/RTCA DO-257A, 2.2.1.1]

Overlaying Symbols

- Careful attention should be given to the symbol priority (priority of displaying one symbol overlaying another symbol by editing out the secondary symbol) to assure that higher priority symbols remain viewable. [HF-HWG Final Report, 7.4.2(e)]
- The ownship symbol shall be unobstructed. [TSO C-165/RTCA DO-257A, 2.2.1.1]

Symbol Position Accuracy

- Symbols should be positioned with sufficient accuracy to avoid interpretation errors or significantly increase interpretation time. [AC 25-11A, 31.c.(3)(a)]
- All displayed symbols and graphics shall be positioned (i.e., drawn or rendered) accurately relative to one another such that placement errors are less than .013 inches on the map depiction or 1% of the shortest axis (i.e., horizontal and vertical dimension) of the map depiction, and orientation errors are less than 3° with respect to the values provided by the position and database sources. [TSO C165/RTCA DO-257A, 2.2.1]
- The display of obstructions shall reflect database precision. [RTCA DO-229D, 2.2.1.1.4.6]

Symbol Appearance on a Display

- Symbols that represent physical objects (for example, navigational aids and traffic) should not be misleading as to the object's physical characteristics (including position, size, envelope, and orientation). [AC 25-11A, 31.c.(3)(a)]

### *2.2 Other Design and Evaluation Considerations*

In addition to the guidance above, manufacturers should consider the following issues.

1. *The symbol or linear pattern should be distinctive*: A symbol or linear pattern is distinctive if it is *easy* to discriminate from other symbols or graphics, even if it differs by only one easy-to-discern feature. A symbol or linear pattern should have a basic shape or characteristic that can be recognized and easily identified by users. This unique global shape or pattern will reduce the potential for confusion. Some manufacturers may choose to enhance the design of the symbol by adding details to create their own look and feel or by modifying the color, fill, and border of the symbol. In these cases, it is especially important to evaluate the symbol or linear pattern to ensure that the enhancements do not add confusion or impact its recognizability. Additionally, if symbols are modified to convey different levels of information, the modifications should be based on an explicit set of rules that are clearly stated. Any modification to the symbol should not interfere with recognition or discrimination of the basic symbol.

   The distinctiveness of a symbol or linear pattern should be evaluated not only within a symbol set but also across symbol sets to ensure that the symbols or linear patterns are consistent with other displays and charts (paper or electronic). This helps to ensure that the symbol or linear pattern will not be confusable with other coding conventions used in the flight deck.
2. *The symbol or linear pattern should be clear and perceptible*. The appearance of information on a display will vary as a function of (a) the optical qualities of the display, (b) the size of the symbol or distinguishing feature in a linear pattern, and (c) the display position.
   (a) Display optical qualities: Display factors affecting legibility include resolution, contrast, brightness, color, and rendering techniques such as anti-aliasing. These factors influence the legibility of the depicted information and the level of detail that can be discerned by the pilot. In particular, some symbols or linear patterns may have fine detail that is difficult to see under degraded display conditions.
   (b) Symbol size: The minimum size at which the symbol is shown (or the minimum size at which the repeating shape in the linear pattern is shown) must preserve the key features. In particular, the smallest visual feature of a symbol (whether it is a stand-alone symbol or part of a linear pattern) that distinguishes it from other symbols and graphics needs to be drawn so that it can be seen easily. Detail will be more difficult to distinguish on a small symbol than on a large one.

Consequently, a minimum size may be specified and this specification may vary depending on characteristics of the display technology.

(c) Display position: The display location can affect the readability of the depicted information; some displays are not easily readable when viewed off-angle. Unfortunately, limited real estate on flight decks may force compromises when installing new displays, and some displays are placed in locations outside the pilot's normal viewing area.

3. *The symbol should be appropriately salient*. The context in which a symbol is presented influences how salient it is or how much it stands out from a cluttered background. The time needed for a pilot to find a symbol is influenced by the total number of items on the display and the number of items close to the target symbol. Since the number of items depicted and their location vary from one display to another, a symbol that may be easy to find in one context may not be easy to find in another context.
4. *The symbol, line, or linear pattern should be easy to interpret*. For symbols, contextual clues (e.g., the position of the symbol relative to other symbols) can assist the pilot in identifying what a symbol represents if the meaning is not obvious. However, the meaning of a symbol should be assessed without contextual clues to discern the meaning conveyed by the symbol itself. In the absence of context, it is easier to distinguish between two symbols than to identify a symbol. Note that a change in a small feature, which may be easily missed, should not imply a significant difference in the operational interpretation.

   Lines and linear patterns may be more difficult to identify and interpret without context than symbols. Lines can only be distinguished by a few features (e.g., line width, line style, and color), and there are many more types of lines than there are combinations of features. Consequently, labels are essential for identifying lines. Labels are also necessary for linear patterns, even if they are unique, because these patterns may not be used frequently, and so they may not be recognized by pilots.

### *2.3 Overview of Volpe Center Research*

The Volpe Center has an established research program to support the FAA in developing guidelines for the approval of electronic displays that show charting information. The Volpe Center works closely with the FAA Human Factors Research and Engineering Group (AJP-61), the FAA Office of Aircraft Certification (AIR-100), and NACO to identify and prioritize research issues. The FAA has provided funding and support for the Volpe Center to work with the SAE G-10 Aeronautical Charting Committee in their efforts to develop symbology recommendations, which may be invoked by ICAO and the FAA.

Early in this research program, it was important to understand the display issues that influence symbology design, use, and interpretability. In 2003, the Volpe Center conducted an informal industry review of commercially available display technologies and interviewed five avionics display manufacturers to understand current display capabilities and their limitations. The Volpe Center also reviewed current symbology standards and recommendations (e.g., in [6], [10], and [12]), and conducted a survey of symbols in use by eight manufacturers and chart providers. The results were used to develop a list of research issues. The issues could be summarized into four basic questions (see Yeh and Chandra [18] for a discussion):

- Is the symbol representative of the symbol type?
- Can all encoded features of the symbol be decoded quickly and accurately?
- Is the symbol easy to find?
- Is the on-screen symbol size appropriate?

The Volpe Center worked with the FAA to prioritize the potential research issues. In 2004, two experiments were conducted to address some of these issues [17, 19]. The first examined the issue of *symbol stereotypes*, i.e., whether there are key features that are necessary for symbols to be recognized. The experiment focused on symbols used for eight navigation aids (DME, fix, NDB, TACAN, VOR, VORDME, VORTAC, and waypoint). Pilots were shown symbols collected from aviation display

manufacturers and published recommendations documents. For each symbol type, pilots were shown a series of test symbols and asked to indicate whether the symbol was representative of the symbol type. The results indicated that pilots associated certain key features with each symbol type, despite variations in the size, color, and fill of those features. Stereotypical symbols were identified for seven of the eight navigation aid symbols, as shown in Table 1 below. The results highlight the importance of consistency in symbol design. Symbols that deviated from what pilots considered to be representative were not well recognized.

| Symbol Type | Example of Recognized Symbols |
|---|---|
| DME | None Identified |
| Fix |  |
| NDB |  |
| TACAN |  |
| VOR |  |
| VORDME |  |
| VORTAC |  |
| Waypoint |  |

**Table 1. Stereotypical symbols.**

The second experiment addressed how symbols could be modified to convey different levels of information. Symbol-feature rules that may be used by some manufacturers to construct navigation aids were tested to determine if pilots could easily learn and apply them. The rules expand the definitions of current symbols so that features of a symbol (e.g., a circle border or its fill) convey specific properties of the navigation aid, such as whether it is a fly-by or fly-over waypoint, or whether it is a compulsory or on-request, reporting point. The results indicated that pilots were generally able to apply the rules to understand the meaning conveyed by the combined symbol features. Not surprisingly, pilots were better able to apply the rules when detailed instructions were provided, e.g., in a legend that explicitly stated the rule and depicted many examples, than when they were asked to infer the rule from viewing a couple of examples. However, modifications that were not salient or that were ambiguous led to misinterpretations. For example, pilots did not differentiate between a circle border that distinguished fly-by versus fly-over waypoints with a circle-like border representing a compass rose surrounding a symbol.

These first experiments provided input to the FAA and the SAE G-10 Aeronautical Charting Committee regarding what symbols were well recognized for navigation aids, and how these symbols could be modified to convey additional information. The next research priority was to examine whether other symbols proposed by the committee for more general symbols were well recognized [14, 16]. In this study, participants were shown symbols representing obstructions, markers, localizers, and airports and asked to identify each symbol in isolation. The purpose of the task was to determine whether pilots could correctly identify the proposed symbols, even though not all of them were familiar. Generally, pilots recognized most of the symbols tested, but a few were not well recognized. These low-recognition symbols included two candidate symbols for a new concept (i.e., a generic localizer), an airport beacon that could not be identified without context, the TAA symbol which was misidentified as an MSA, and a symbol currently in use but rarely shown on electronic displays (i.e., a double-ringed NDB symbol used on some navigation displays).

Three other research issues were addressed as part of the same study. One issue was whether frequency information in the symbol label increased pilots' accuracy in identifying navigation aids. Pilots were shown five different navigation aids, each with and without frequency information, and asked to identify them. The results indicated that most of the navigation aids were identifiable without frequency information; that is, these symbols were well recognized by themselves. However, only accuracy data was collected. Consequently, the task did not comprehensively examine the effect of labeling information and whether its use facilitates the speed of symbol identification.

A second research issue was to understand pilots' associations between navigation aids to identify "symbol families" that could potentially be represented by a single symbol on the electronic display. Some manufacturers already represent several navigation aids using one symbol, but the groupings are not consistent among manufacturers. Pilots were asked to group eight commonly used navigation aids into related sets. The results indicated that pilots see similarities among navigation aids as a function of the type of information provided (e.g., distance information, radial/bearing information, or the latitude/longitude of a point). The amount of information provided by the navigation aid, its utility, and technology were also considered. The actual symbol groups constructed by pilots are provided in the detailed report [16].

The final research issue was to examine pilots' understanding of line style conventions used on paper chart and electronic moving map displays. Pilots were shown a list of linear elements and asked to identify which lines were used to represent that element. The lines varied in thickness and whether they were solid or dashed. Pilots were able to identify most of the lines used on paper charts, where standards are well established, although they were not necessarily reliable at distinguishing between similar line widths (e.g., medium versus thick lines) or similar dash lengths. Pilots understanding of line conventions on electronic moving map displays were more varied, indicating either that pilots did not know the conventions, or that the conventions are not well established on these displays.

Lines and linear patterns were addressed in more detail in a study addressing their utility and recognition [14]. The three-part study was conducted to identify linear patterns for which industry recommendations were needed and to determine which linear patterns were already well-recognized. In the first part of the study, pilots sorted the names of 65 lines and linear patterns into three categories: "Very Useful", "Recognize and Use on Occasion", and "Do Not Use/Do Not Recognize". Data from the sorting task were examined with respect to different pilot characteristics (e.g., qualifications, types of flight operations, typical flight length), and the items identified in each category varied as a function of those characteristics.

The second part of the study examined pilots' recognition of line patterns. Subject matter experts selected nine test patterns that they expected to be relatively recognizable. Pilots were asked to identify each test pattern, which was shown in isolation and without color. While the results suggested that the task was difficult, some of the line patterns were identified more accurately than others.

Finally, in the third part of the study, pilots were asked to rate the importance of lines, the difficulty of interpreting lines on paper charts, and the difficulty of interpreting lines on electronic charts and map displays. Pilots were also asked to provide additional comments on the topic area in general. The ratings indicated that pilots who reported flying private operations considered line information to be more important to their flights than pilots who reported flying air transport operations. Additionally, the ratings and comments suggested that line information was sometimes easier to interpret on electronic displays than paper charts. This is likely due to the fact that electronic displays provide less information to the pilot than paper aeronautical charts. Electronic displays can contain less information than paper charts because they are generally intended to be used *in conjunction* with paper charts.

# 3 Navigation Aids

Symbols for navigation aids are provided in the tables below. The symbols are grouped according to whether they are shown only on electronic displays or whether they are chart symbols, which may be shown on paper as well as displayed electronically. Of the chart providers, only ICAO recommends different symbols for some navigation aids depending on the display medium; both symbols are included here, and footnotes denote the distinction. If a specific symbol is not depicted by the manufacturer or chart provider, then "Not Depicted" is indicated in the table. Manufacturer notes regarding their symbology are provided in Appendix A.

The tables indicate whether the manufacturer encodes information in the symbol (e.g., reporting or fly-by/fly-over requirements). Variation in the symbol's depiction is noted, where applicable. Most commonly, *chart symbols* distinguish between compulsory and on-request reporting, usually by filling-in the symbol to indicate compulsory reporting, and fly-by and fly-over requirements, by drawing a circle around the symbol to indicate a fly-over requirement. The conventions used may differ depending on whether the symbol is an intersection, waypoint, or navigation aid. For example, Jeppesen uses a circle outline to differentiate between fly-by or fly-over status for intersections and waypoints but indicates fly-over status for navigation aid symbols with a text note only. Lido distinguishes fly-by or fly-over status for waypoints on RNAV (Area Navigation) STAR (Standard Arrival Route) and RNAV SID (Standard Instrument Departure) charts only; this distinction is not provided for navigation aids. As the tables will show, most of the current-generation electronic display symbols do not make these distinctions, with the exception of the waypoint symbology used by Honeywell, which distinguishes only between fly-by and fly-over status. This may change in the future as the market shifts and electronic displays are used to replace paper charts, because all the information currently depicted on paper would need to be available.

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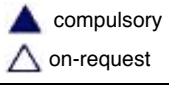
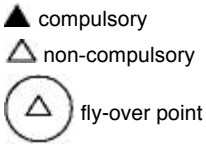
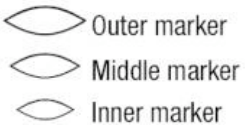
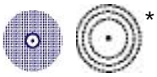
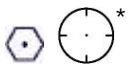
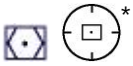
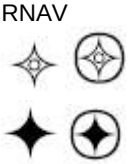
All other symbology provided courtesy of Airbus, Avidyne, Boeing, Honeywell, L-3 Communications, Rockwell Collins, Smiths, Universal, ICAO, FAA/NACO, and Lufthansa Systems (Lido).

| | Manufacturer | DME | Intersection | Locator | LOM | Markers (Enroute, Inner, Middle) |
|---|---|---|---|---|---|---|
| Electronic Display Symbols | **Airbus** |  | Not Depicted | Not Depicted | Not Depicted | ILS marker beacon  |
| | **Avidyne** | Not Depicted |  | Not Depicted | Not Depicted | Not Depicted |
| | **Boeing** | Not Depicted | Not Depicted | Not Depicted |  | Not Depicted |
| | **Garmin** |  |  | Not Depicted |  |   |
| | **Honeywell** |  Alternate symbol  |  | Not Depicted | Depicted with NDB  | Not Depicted |
| | **L-3 Communications** |  |  | Marker combined with NDB | Marker combined with NDB |  |
| | **Rockwell Collins** |  |  | Not Depicted | Not Depicted | Not Depicted |
| | **Smiths** |  |  | Not Depicted | Not Depicted |   |
| | **Universal** |  | Not Depicted | Not Depicted | Not Depicted |   |
| Chart Symbols | **ICAO** |  |  compulsory on-request | Not Depicted | Not Depicted |  elliptical bone-shaped |
| | **FAA/NACO** |  |  compulsory non-compulsory fly-over point |  |  |  |
| | **Jeppesen** |  |  compulsory non-compulsory fly-over |  |  | Marker beacon  |
| | **Lido** |  |  |  |  |  Outer marker Middle marker Inner marker |

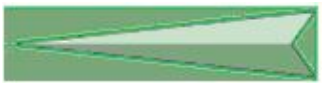
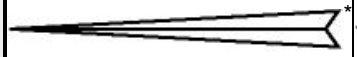
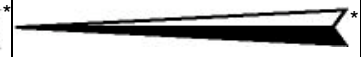
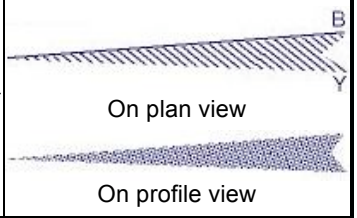
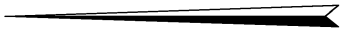
| | Manufacturer | Meteorological reporting point | Mileage break/ turn point | NDB | TACAN |
|---|---|---|---|---|---|
| Electronic Display Symbols | **Airbus** | Not Depicted | Not Depicted |  |  |
| | **Avidyne** | Not Depicted | Not Depicted |  | Not Depicted |
| | **Boeing** | Not Depicted | Not Depicted |  |  |
| | **Garmin** | Not Depicted | Not Depicted |  |  |
| | **Honeywell** | Not Depicted | Not Depicted |  |  Alternate symbol  |
| | **L-3 Communications** | Not Depicted | Not Depicted |  |  |
| | **Rockwell Collins** | Not Depicted | Not Depicted |  |  |
| | **Smiths** | Not Depicted | Not Depicted |  |  |
| | **Universal** | Not Depicted | Not Depicted |  |  |
| Chart Symbols | **ICAO** |  compulsory  on-request | Not Depicted |  * |  |
| | **FAA/NACO** | Not Depicted |  |  |  |
| | **Jeppesen** |  |  |  |  |
| | **Lido** | Not Depicted |   |  |  |

* Specified for depiction on electronic displays (right symbol only).

| | Manufacturer | VOR | VORDME | VORTAC | Waypoint | Other Navigation Aid Symbols |
|---|---|---|---|---|---|---|
| Electronic Display Symbols | Airbus |  |  |  |  | |
| | Avidyne |  |  |  |  | |
| | Boeing |  |  |  | along route  off-route  | |
| | Garmin |  |  |  |  waypoint<br>  vertical navigation along track<br>  parallel track waypoint | |
| | Honeywell |  Alternate Symbol  |  Alternate Symbol  |  | along route  off-route  <br>  fly-over waypoint |  Optional navaid at large ranges (e.g., when zoomed out) |
| | L-3 Communications |  |  |  |  | |
| | Rockwell Collins |  |  |  |  | |
| | Smiths |  |  |  |  | |
| | Universal |  |  |  |  | |

| | Manufacturer | VOR | VORDME | VORTAC | Waypoint | Other Navigation Aid Symbols |
|---|---|---|---|---|---|---|
| Chart Symbols | ICAO |  * |  * |  * |  fly-by<br>  fly-over | |
| | FAA/NACO |  |  |  |  fly-by, on request<br>  fly-by compulsory<br>  fly-over | Compulsory – filled in<br>Fly-over – surrounded by circle |
| | Jeppesen |  |  |  |  non-compulsory<br>  compulsory<br>  fly-over |  <br>Generic navigation aid; Depicted at large scale/ range, i.e., high altitude or plotting charts |
| | Lido |  |  |  |  RNAV  | |

* Specified for depiction on electronic displays (right symbol only).

| | Manufacturer | Localizer, front course | Localizer, back course | Other Localizer Symbols |
|---|---|---|---|---|
| Electronic Display Symbols | **Airbus** | Not Depicted | Not Depicted | |
| | **Avidyne** | Not Depicted | Not Depicted | |
| | **Boeing** | Not Depicted | Not Depicted | |
| | **Garmin** | Depicted; Image not available | Depicted; Image not available | |
| | **Honeywell** |  | Not Depicted |  |
| | **L-3 Communications** |  |  | |
| | **Smiths** | Not Depicted | Not Depicted | |
| | **Rockwell Collins** | Not Depicted | Not Depicted | |
| | **Universal** | Not Depicted | Not Depicted | |
| Chart Symbols | **ICAO** |  |  |  On plan view On profile view |
| | **FAA/NACO** |  |  |  SDF |
| | **Jeppesen** |  |  | |
| | **Lido** |  |  |  Localizer for converging ILS |

* Specified for depiction on electronic displays.

# 4 Airports

The airport symbols currently in use are shown in the following tables. Similar to the navigation aids, not all airport attributes listed were depicted by all the manufacturers. If a specific airport symbol is not depicted, then “Not Depicted” is indicated in the table. Some manufacturers also provided airport symbols that they depicted that were not specifically requested in the industry survey. These symbols are included under the heading “Other Airport Symbols”.

Manufacturer notes regarding their symbology are provided in Appendix A.

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Lufthansa Systems (Lido): General airport symbols – Lufthansa Systems (Lido) Trademark (pending).

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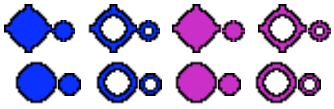
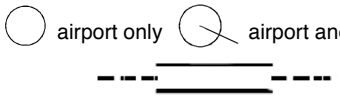
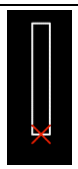
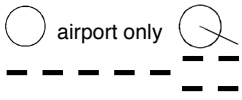
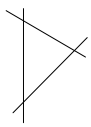
| | Manufacturer | General | Civil | Military | Joint Civil-Military | Heliports |
|---|---|---|---|---|---|---|
| Electronic Display Symbols | **Airbus** | |  The origin or destination waypoint is an airport, and the runway is not specified. Note: For airport at mid-range, the runway symbol associated with the flight plan (origin or destination, and not any other RWY) becomes an empty rectangle oriented with respect to QFU. At smaller ranges (i.e., zoomed in), the rectangle (which becomes a pair of lines on the A380) length and orientation conforms to the runway. At even smaller ranges on the A380, the airport navigation function appears (airport moving map). | | | |
| | **Avidyne** | |  | | | Not Depicted |
| | **Boeing** | |  Note: Some airplanes display an Airport Moving Map which can be displayed with a level of detail as a function of display range scale. | | | Not Depicted |
| | **Garmin** | |  | Depicted; Image not available | Depicted; Image not available |  |
| | **Honeywell** | |  airport |  optional airport at small range (zoomed in) |  optional airport at large range (zoomed out) | |
| | **L-3 Communications** | |  Hard surface no tower<br>Hard surface tower<br>Soft surface no tower<br>Soft surface tower | Not Depicted |  Hard surface no tower<br>Hard surface tower<br>Soft surface no tower<br>Soft surface tower | Not Depicted |
| | **Smiths** |  Runway |  |  |  | Not Depicted |
| | **Rockwell Collins** |  |  Note: The symbol displayed is a function of display range scale. | | | Not Depicted |
| | **Universal** |  | Not Depicted | Not Depicted | Not Depicted | Not Depicted |

| | Manufacturer | General | Civil | Military | Joint Civil-Military | Heliports |
|---|---|---|---|---|---|---|
| Chart Symbols | ICAO |  |  |  |  |  |
| | FAA/NACO | |  |  |  |  |
| | Jeppesen | Primary Airport Sketch  Approach  SID/STAR |  |  |  |  |
| | Lido |  Lido Trademark (pending) |  Differentiation applies only to airport size category | | |  |

| | Manufacturer | Civil Seaport | Military Seaport | Joint Civil-Military Seaport | Closed Airport | Other Airport Symbols |
|---|---|---|---|---|---|---|
| Electronic Display Symbols | **Airbus** | Not Depicted | Not Depicted | Not Depicted | Not Depicted | |
| | **Avidyne** |  | Not Depicted | Not Depicted | Not Depicted | |
| | **Boeing** | Not Depicted | Not Depicted | Not Depicted | No method to distinguish closed |  Alternate airport |
| | **Garmin** | Not Depicted | Not Depicted | Not Depicted | Not Depicted |  Private  Unknown |
| | **Honeywell** | Not Depicted | Not Depicted | Not Depicted | Not Depicted | |
| | **L-3 Communications** |  | Not Depicted |  | Not Depicted | |
| | **Smiths** | Not Depicted | Not Depicted | Not Depicted | Not Depicted | |
| | **Rockwell Collins** | Not Depicted | Not Depicted | Not Depicted | Not Depicted | |
| | **Universal** | Not Depicted | Not Depicted | Not Depicted | Not Depicted | |
| Chart Symbols | **ICAO** |  |  |  |  | |
| | **FAA/NACO** |  | Not Depicted | Not Depicted |  | |
| | **Jeppesen** |  |  | Not Depicted |  | |
| | **Lido** | Not Depicted | Not Depicted | Not Depicted | Not Depicted | Nearby Airport Symbol   |

# 5 Lines and Linear Patterns

The lines and linear patterns used to depict airspaces and boundaries were organized into six categories, as listed below: routes/flight tracks, airspaces, areas/regions, zones, geographical features, and other. The tables show that the lines and linear patterns depicted and the level of detail used vary as a function of the display medium (i.e., whether it is being depicted on paper or electronic display). Notes in the tables identify a few of the lines that are shown only on charts used under visual flight conditions. Consistent with the previous tables, if a specific line or linear pattern is not depicted, then "Not Depicted" is indicated in the table. Some manufacturers also provided symbols that were not specifically requested in the industry survey. This information is included under the heading "Other Symbols" in the appropriate subsection. Manufacturer notes are provided in Appendix A. Definitions for some lines and linear patterns that are less common and therefore expected to be less well known (particularly those for areas/regions and zones) are provided in Appendix B.

Note that airspaces and boundaries are not depicted on current Airbus navigation displays, so Airbus is not included in the tables in this section. Procedures, airways, and holding patterns will appear on Airbus navigation displays if they are input in the FMS as part of the flight plan. They are depicted as dashed lines if they are part of the temporary flight plan, and solid lines if they are part of the primary flight plan; these procedures, airways, and holding patterns are not symbols but effectively segments of the flight plan.

**5.1 Routes/Flight Tracks**

Alternate, Conditional or Uncontrolled Enroute Airway or ATS Route
Enroute Airway or ATS Route
Enroute ATC Holding Pattern
Missed Approach Procedure Holding Pattern
Missed Approach Procedure Track
Radar Vector Track
Terminal Arrival Holding Pattern
Terminal Holding Pattern in Lieu of Procedure Turn
Terminal Procedure Flight Track
Terminal Transition or Feeder Route (Arr/Dep/Appr)
Visual Flight Path

**5.2 Airspaces**

Class A Airspace
Class B Airspace
Class C Airspace
Class D Airspace
Class E Airspace
Class F Airspace
Class G Airspace
Special VFR NA (Fixed Wing) Airspace

**5.3 Areas/Regions**

Air Route Traffic Control Center (ARTCC)
Airport Radar Service Area (ARSA)
Alert Areas (A)
Altimeter Setting Regions (QFE/QNH)
Balloon Launch Area
Caution Areas
CNS/ATM Equipment Requirement Areas
Control Area (CTA/CTL)

Danger Areas (D)
Flight Information Region/ Upper Flight Information Region (FIR/UIR)
Military Operations Area (MOA)
National Security Area (NSA) (United States)
Oceanic Control Area (OCA)
Positive Control Area (PCA)
Prohibited Airspace Area (P)
Restricted Airspace Area (R)
Speed Limit Area
Temporary Flight Restriction Area (TFR)
Temporary Reserve/ Segregated Areas (TRA)
Terminal Control Area (TCA/TMA)
Terminal Radar Service Area (TRSA)
Traffic Information Area/Zone (TIA)
Training Areas
Upper Control Area (UCA/UTA)
Warning Areas

**5.4 Zones**
Air Defense Identification Zones (ADIZ)
Air Traffic Zone (ATZ)/Control Zone (CTZ/CTR)
Buffer Zone/Non-Free Flying Zone
Helicopter Traffic Zone (HTZ)/Protected Zone (HPZ)
Military Control Zone (MCTR)/Air Traffic Zone (MATZ)
Special Rules Area/Zone (SRZ)

**5.5 Geographical Features**
Bluff
City pattern
Contours
Lake or Pond
Railroad (single or multiple track)
River or stream
Road (single or multi-lane)
Shoreline
Telephone or Power Lines

**5.6 Other Lines**
Country (State) Boundary
Formation Radial or Bearing (Enroute & Terminal)
International Date Line
Isogonic Lines
Time Zone Boundary

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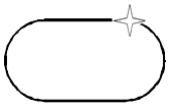
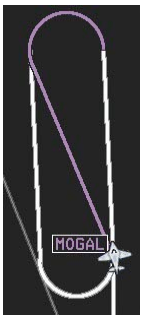
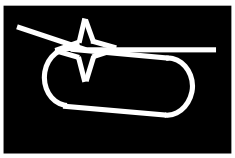
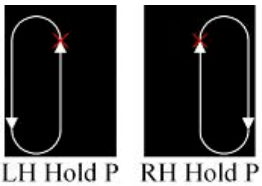
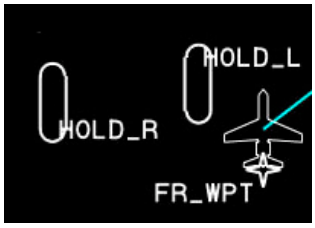
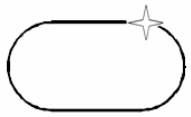
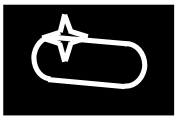
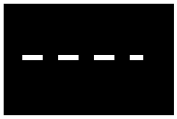
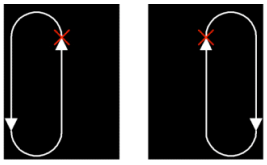
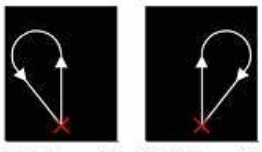
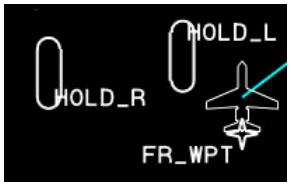
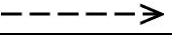
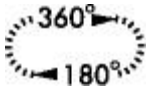
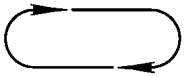
All other symbology provided courtesy of Avidyne, Boeing, Honeywell, L-3 Communications, Rockwell Collins, Smiths, Universal, ICAO, FAA/NACO, and Lufthansa Systems (Lido).

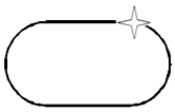
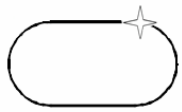
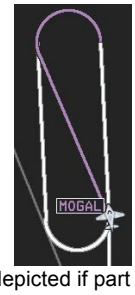
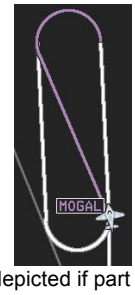
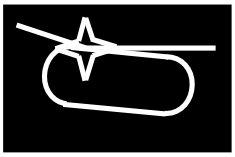
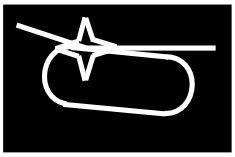
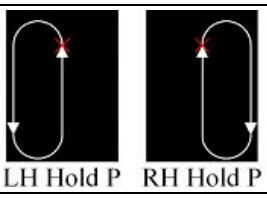
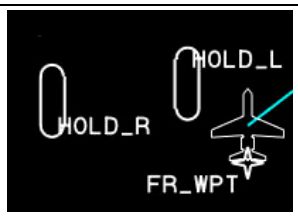
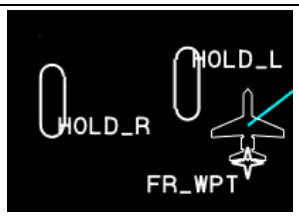
### *5.1 Routes/Flight Tracks*

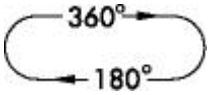
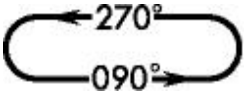
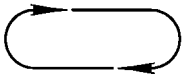
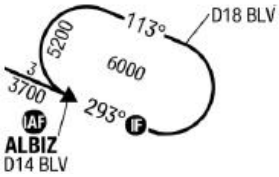
| | Manufacturer | Alternate, Conditional or Uncontrolled Enroute Airway or ATS Route | Enroute Airway or ATS Route | Enroute ATC Holding Pattern |
|---|---|---|---|---|
| Electronic Display Symbols | **Avidyne** | Not Depicted |  | Not Depicted |
| | **Boeing** | Not Depicted | Not Depicted<br>FMS Route only |  |
| | **Garmin** |  <br>Low Altitude Airway<br>  <br>High Altitude Airway |  <br>Low Altitude Airway<br>  <br>High Altitude Airway |  <br>Only depicted if part of flight plan |
| | **Honeywell** |  |  |  |
| | **L-3 Communications** |  |  |  |
| | **Rockwell Collins** |  |  |  |
| | **Smiths** | Not Depicted | Not Depicted |  |
| | **Universal** | Not Depicted | Not Depicted |  |

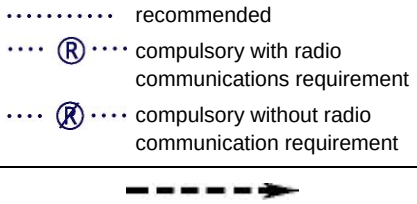
| | Manufacturer | Alternate, Conditional or Uncontrolled Enroute Airway or ATS Route | Enroute Airway or ATS Route | Enroute ATC Holding Pattern |
|---|---|---|---|---|
| Chart Symbols | **ICAO** |  | Alternative  |  |
| | **FAA/NACO** |   uncontrolled |   VOR airway / jet route   ATS route |  |
| | **Jeppesen** |  |  |  |
| | **Lido** | Alternate or Conditional airways are not depicted.<br>Controlled Enroute Airway or ATS Route is depicted without gray shade:<br>  <br>Uncontrolled airspace (Class F,G) is shown with gray shade. |   |   |

| | Manufacturer | Missed Approach Procedure Holding Pattern | Missed Approach Procedure Track | Radar Vector Track |
|---|---|---|---|---|
| Electronic Display Symbols | **Avidyne** | Depicted; Image not available | Depicted; Image not available | Not Depicted |
| | **Boeing** |  |  | Not Depicted |
| | **Garmin** |  |  | Not Depicted |
| | **Honeywell** |  Med dashed line<br>  Thin solid line |  Med dashed line<br>  Thin solid line | Not depicted |
| | **L-3 Communications** | Only when part of flight plan (white when not active, magenta when active, Cyan when in Flight Plan Edit mode); Image not available | Only when part of flight plan (white when not active, magenta when active, Cyan when in Flight Plan Edit mode); Image not available | Not Depicted |
| | **Rockwell Collins** |  <br>Prior to Missed Approach execution<br>  <br>During Missed Approach execution |  <br>Prior to Missed Approach execution<br>  <br>During Missed Approach execution | Not Depicted |
| | **Smiths** |  |  | Not Depicted |
| | **Universal** |  | Not Depicted | Not Depicted |

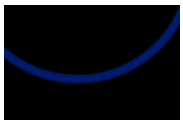
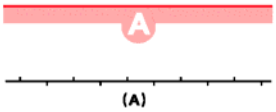
| | Manufacturer | Missed Approach Procedure Holding Pattern | Missed Approach Procedure Track | Radar Vector Track |
|---|---|---|---|---|
| Chart Symbols | **ICAO** | Not Depicted |  | Not Depicted |
| | **FAA/NACO** |  |  | Not Depicted |
| | **Jeppesen** |  |  |  |
| | **Lido** |  Note: Differing Missed APCH MHA shown in blue |  Note: Shown in Missed APCH blue |  |

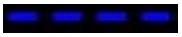
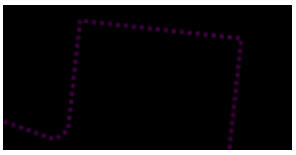
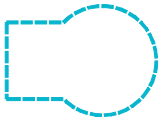
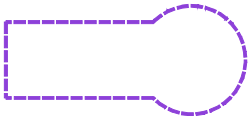
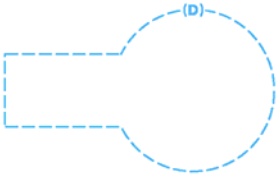
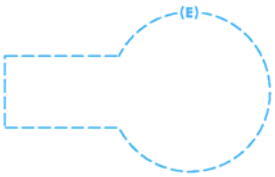
| | Manufacturer | Terminal Arrival Holding Pattern | Terminal Holding Pattern in Lieu of Procedure Turn | Terminal Procedure Flight Track |
|---|---|---|---|---|
| Electronic Display Symbols | **Avidyne** | Depicted; Image not available | Not Depicted | Not Depicted |
| | **Boeing** |  |  | FMS Route only |
| | **Garmin** |  Only depicted if part of flight plan |  Only depicted if part of flight plan | Depicted; Image not available |
| | **Honeywell** |  |  | Not Depicted |
| | **L-3 Communications** |  | Only when part of flight plan (white when not active, magenta when active, Cyan when in Flight Plan Edit mode); Image not available | Only when part of flight plan (white when not active, magenta when active, Cyan when in Flight Plan Edit mode) ; Image not available |
| | **Rockwell Collins** |  |  | FMS Route only |
| | **Smiths** |  | Not Depicted | Not Depicted |
| | **Universal** |  Shown off the flight plan |  Shown off the flight plan | Not Depicted |

| | Manufacturer | Terminal Arrival Holding Pattern | Terminal Holding Pattern in Lieu of Procedure Turn | Terminal Procedure Flight Track |
|---|---|---|---|---|
| Chart Symbols | ICAO |  | Not Depicted |  |
| | FAA/NACO |  |  |  |
| | Jeppesen |  |  |  |
| | Lido |  |  |  |

| | Manufacturer | Terminal Transition or Feeder Route (Arrival, Departure, Approach) | Visual Flight Path |
|---|---|---|---|
| Electronic Display Symbols | **Avidyne** | Not Depicted | Not Depicted |
| | **Boeing** | FMS Route only | Not Depicted |
| | **Garmin** |  | Not Depicted |
| | **Honeywell** | Not Depicted | Not Depicted |
| | **L-3 Communications** | White line when not active,<br>Magenta when active,<br>Cyan when in Flight Plan Edit mode;<br>Image not available | Not Depicted |
| | **Rockwell Collins** | FMS Route only | Not Depicted |
| | **Smiths** | Not Depicted | Not Depicted |
| | **Universal** | Not Depicted | Not Depicted |
| Chart Symbols | **ICAO** |  |  |
| | **FAA/NACO** |  |  |
| | **Jeppesen** | <br>SID/STAR<br><br>Approach |  |
| | **Lido** |  |  |

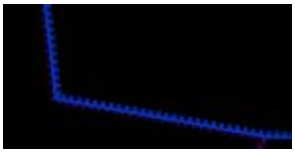
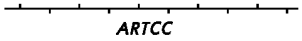
## *5.2 Airspaces*

| | Manufacturer | Class A Airspace | Class B Airspace | Class C Airspace |
|---|---|---|---|---|
| Electronic Display Symbols | **Avidyne** | Not Depicted |  |  |
| | **Boeing** | Not Depicted |  |  |
| | **Garmin** | Not Depicted |  |  |
| | **Honeywell** | Not Depicted |  |  |
| | **L-3 Communications** | Not Depicted |  |  |
| | **Rockwell Collins** | Not Depicted |  |  |
| | **Smiths** | Not Depicted | Not Depicted | Not Depicted |
| | **Universal** | Not Depicted | Not Depicted | Not Depicted |
| Chart Symbols | **ICAO** |   |   |   |
| | **FAA/NACO** | Open [white] area on IFR chart. Not depicted on VFR charts |  |  |
| | **Jeppesen** |   |   |   |
| | **Lido** |   |   |   |

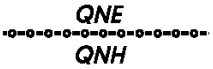
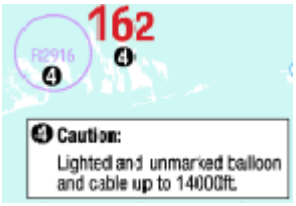
| | Manufacturer | Class D Airspace | Class E Airspace | Class F Airspace |
|---|---|---|---|---|
| Electronic Display Symbols | **Avidyne** |  | Not Depicted | Not Depicted |
| | **Boeing** |  | Not Depicted | Not Depicted |
| | **Garmin** |  | Not Depicted | Not Depicted |
| | **Honeywell** |  | Not Depicted | Not Depicted |
| | **L-3 Communications** |  |  | Not Depicted |
| | **Rockwell Collins** | Not Depicted | Not Depicted | Not Depicted |
| | **Smiths** | Not Depicted | Not Depicted | Not Depicted |
| | **Universal** | Not Depicted | Not Depicted | Not Depicted |
| Chart Symbols | **ICAO** |   |   |   |
| | **FAA/NACO** | Open [white] area on IFR chart.<br>Depiction on VFR charts:<br>  | Open [white] area on IFR chart.<br>Depiction on VFR charts:<br>  | Not Depicted |
| | **Jeppesen** |   |   | Not Depicted |
| | **Lido** |   | Not Depicted |  <br>As uncontrolled airspace, Class F, G is shown with grey shade. |

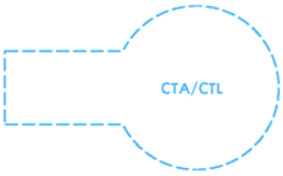
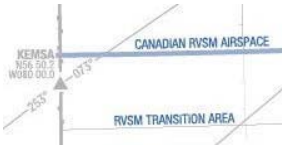
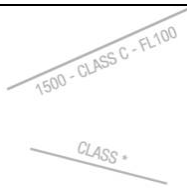
| | Manufacturer | Class G Airspace | Special VFR NA (Fixed Wing) Airspace |
|---|---|---|---|
| Electronic Display Symbols | **Avidyne** | Not Depicted | Not Depicted |
| | **Boeing** | Not Depicted | Not Depicted |
| | **Garmin** | Not Depicted | Not Depicted |
| | **Honeywell** | Not Depicted | Not Depicted |
| | **L-3 Communications** | Not Depicted | Not Depicted |
| | **Rockwell Collins** | Not Depicted | Not Depicted |
| | **Smiths** | Not Depicted | Not Depicted |
| | **Universal** | Not Depicted | Not Depicted |
| Chart Symbols | **ICAO** |   | Not Depicted |
| | **FAA/NACO** |  |  Special Federal Aviation Regulations (SFAR) Areas depicted only on VFR charts |
| | **Jeppesen** |  |  |
| | **Lido** |   As uncontrolled airspace, Class F, G is shown with grey shade. | Not Depicted |

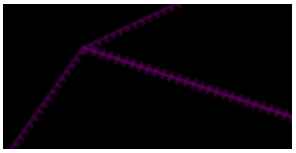
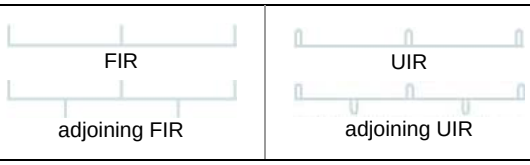
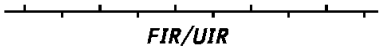
### *5.3 Areas/Regions*

| | Manufacturer | Air Route Traffic Control Center (ARTCC) | Airport Radar Service Area (ARSA)[1] | Alert Areas (A) |
|---|---|---|---|---|
| Electronic Display Symbols | **Avidyne** | Not Depicted | Not Depicted |  Line patterns and detail depicted vary by system. |
| | **Boeing** |  |  |  |
| | **Garmin** |  |  |  |
| | **Honeywell** | Not Depicted | Not Depicted | Not Depicted |
| | **L-3 Communications** | Not Depicted | Not Depicted |  |
| | **Rockwell Collins** | Not Depicted | Not Depicted | Not Depicted |
| | **Smiths** | Not Depicted | Not Depicted | Not Depicted |
| | **Universal** | Not Depicted | Not Depicted | Not Depicted |
| Chart Symbols | **ICAO** | Not Depicted | Not Depicted | Not Depicted |
| | **FAA/NACO** |  | Not Depicted |  |
| | **Jeppesen** |  |  |  |
| | **Lido** |  | Not Depicted | Same as Danger Area (D; prefix A)<br>  |

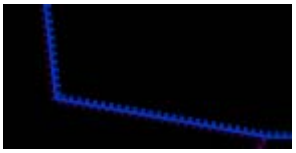
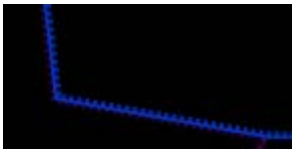
[1] The majority of ARSAs have been reclassified to Class C airspace.

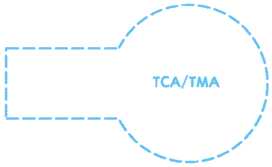
| | Manufacturer | Altimeter Setting Regions (QFE/QNH) | Balloon Launch Area | Caution Areas (C) |
|---|---|---|---|---|
| Electronic Display Symbols | **Avidyne** | Not Depicted | Not Depicted | Not Depicted |
| | **Boeing** | Not Depicted | Not Depicted |  |
| | **Garmin** | Not Depicted | Not Depicted |  |
| | **Honeywell** | Not Depicted | Not Depicted | Not Depicted |
| | **L-3 Communications** | Not Depicted | Not Depicted | Not Depicted |
| | **Rockwell Collins** | Not Depicted | Not Depicted | Not Depicted |
| | **Smiths** | Not Depicted | Not Depicted | Not Depicted |
| | **Universal** | Not Depicted | Not Depicted | Not Depicted |
| Chart Symbols | **ICAO** | Not Depicted | Not Depicted | Not Depicted |
| | **FAA/NACO** |  | Not Depicted | Not Depicted |
| | **Jeppesen** |  | <br>(Australia only) |  |
| | **Lido** | Not Depicted.<br>Affected Airports Shown With M QFE/FT QNH Conversion Tables | Same as Restricted Area (R) with possible text explanation as Caution Note<br>  | Not Depicted |

| | Manufacturer | CNS/ATM Equipment Requirement Areas | Control Area (CTA/CTL) | Danger Areas (D) |
|---|---|---|---|---|
| Electronic Display Symbols | **Avidyne** | Not Depicted | Not Depicted | Not Depicted |
| | **Boeing** | Not Depicted |  |  |
| | **Garmin** |  | Depicted; Image not available |  |
| | **Honeywell** | Not Depicted | Not Depicted | Not Depicted |
| | **L-3 Communications** | Not Depicted | Not Depicted |  |
| | **Rockwell Collins** | Not Depicted | Not Depicted | Not Depicted |
| | **Smiths** | Not Depicted | Not Depicted | Not Depicted |
| | **Universal** | Not Depicted | Not Depicted | Not Depicted |
| Chart Symbols | **ICAO** | Not Depicted |  |  |
| | **FAA/NACO** |  Only Mode C Used |  |  |
| | **Jeppesen** |   Mode C is not depicted |   |   |
| | **Lido** |   |   |   |

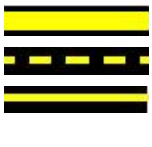
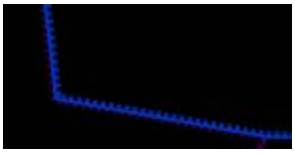
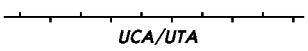
| | Manufacturer | Flight Information Region/Upper Flight Information Region (FIR/UIR) | Military Operations Area (MOA) |
|---|---|---|---|
| Electronic Display Symbols | **Avidyne** | Not Depicted |  <br>Other lines in use:<br> Active<br>  Inactive<br>  Unknown/ Pending<br>Lines and detail depicted vary by system. |
| | **Boeing** |  |  |
| | **Garmin** | Not Depicted |  |
| | **Honeywell** | Not Depicted | Not Depicted |
| | **L-3 Communications** | Not Depicted |  |
| | **Rockwell Collins** | Not Depicted | Not Depicted |
| | **Smiths** | Not Depicted | Not Depicted |
| | **Universal** | Not Depicted | Not Depicted |
| Chart Symbols | **ICAO** |  | Not Depicted |
| | **FAA/NACO** |  <br>FIR<br>UIR<br>adjoining FIR<br>adjoining UIR |  <br>EXCLUSION AREA AND NOTE<br>WALL 1 MOA<br>WALL 2 MOA<br>Internal lines delimit separation of the same Special Use Area or Exclusion Areas |
| | **Jeppesen** |  <br>FIR/UIR |  <br>FALCON MOA |
| | **Lido** |  <br>FRANCE FIR LFFF<br>UIR<br>  <br>combined FIR/UIR | Not Depicted |

| | Manufacturer | National Security Area (NSA) (United States) | Oceanic Control Area (OCA) | Positive Control Area (PCA) |
|---|---|---|---|---|
| Electronic Display Symbols | **Avidyne** | Not Depicted | Not Depicted | Not Depicted |
| | **Boeing** | Not Depicted |  |  |
| | **Garmin** | Not Depicted | Not Depicted | Not Depicted |
| | **Honeywell** | Not Depicted | Not Depicted | Not Depicted |
| | **L-3 Communications** | Not Depicted | Not Depicted | Not Depicted |
| | **Rockwell Collins** | Not Depicted | Not Depicted | Not Depicted |
| | **Smiths** | Not Depicted | Not Depicted | Not Depicted |
| | **Universal** | Not Depicted | Not Depicted | Not Depicted |
| Chart Symbols | **ICAO** | Not Depicted | Not Depicted | Not Depicted |
| | **FAA/NACO** |  Depicted on VFR charts only |  | Not Depicted |
| | **Jeppesen** | Not Depicted |  OCA | Not Depicted |
| | **Lido** | Not Depicted | OCA with respective text label of area concerned  | Not Depicted |

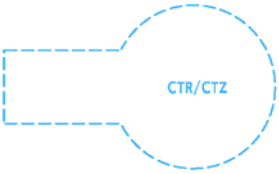
| | Manufacturer | Prohibited Airspace Area (P) | Restricted Airspace Area (R) | Speed Limit Area |
|---|---|---|---|---|
| Electronic Display Symbols | **Avidyne** | Active<br>Inactive<br>Unknown/ Pending<br>Lines and detail depicted vary by system. | Active<br>Inactive<br>Unknown/ Pending<br>Lines and detail depicted vary by system. | Not Depicted |
| | **Boeing** |  |  | Not Depicted |
| | **Garmin** |  |  | Not Depicted |
| | **Honeywell** | Not Depicted |  | Not Depicted |
| | **L-3 Communications** |  |  | Not Depicted |
| | **Rockwell Collins** |  |  | Not Depicted |
| | **Smiths** | Not Depicted | Not Depicted | Not Depicted |
| | **Universal** | Not Depicted | Not Depicted | Not Depicted |
| Chart Symbols | **ICAO** |  |  | Not Depicted |
| | **FAA/NACO** |  |  | Not Depicted |
| | **Jeppesen** |  |  |  |
| | **Lido** | Shown with vertical limits<br>  |  | Normally shown with speed limit points (SLPs)<br>  |

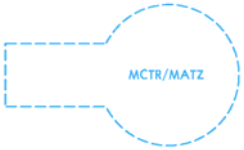
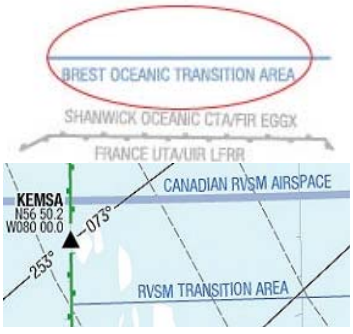
| | Manufacturer | Temporary Flight Restriction Area (TFR) | Temporary Reserve/Segregated Areas (TRA) | Terminal Control Area (TCA/TMA) |
|---|---|---|---|---|
| Electronic Display Symbols | **Avidyne** |  Lines and detail depicted vary by system. | Not Depicted | Not Depicted |
| | **Boeing** | Not Depicted | Not Depicted |  |
| | **Garmin** |  | Depicted; Image not available | Depicted; Image not available |
| | **Honeywell** | Not Depicted | Not Depicted | Not Depicted |
| | **L-3 Communications** | Red Solid; Image not available | Not Depicted |  |
| | **Rockwell Collins** |  | Not Depicted |  |
| | **Smiths** | Not Depicted | Not Depicted | Not Depicted |
| | **Universal** | Not Depicted | Not Depicted | Not Depicted |
| Chart Symbols | **ICAO** | Not Depicted | Not Depicted | Alternative  |
| | **FAA/NACO** |  Depicted on VFR charts only | Not Depicted | Now called Class B |
| | **Jeppesen** |  |  |  |
| | **Lido** | Not Depicted |  TRA  TSA | RFC symbol:  In terminal charts shown only where operationally required |

| | Manufacturer | Terminal Radar Service Area (TRSA) | Traffic Information Area/Zone (TIA/TIZ) | Training Areas (T) |
|---|---|---|---|---|
| Electronic Display Symbols | **Avidyne** | Not Depicted | Not Depicted | Not Depicted |
| | **Boeing** | Not Depicted | Not Depicted |  |
| | **Garmin** |  | Not Depicted |  |
| | **Honeywell** | Not Depicted | Not Depicted | Not Depicted |
| | **L-3 Communications** | Not Depicted | Not Depicted | Not Depicted |
| | **Rockwell Collins** | Not Depicted | Not Depicted | Not Depicted |
| | **Smiths** | Not Depicted | Not Depicted | Not Depicted |
| | **Universal** | Not Depicted | Not Depicted | Not Depicted |
| Chart Symbols | **ICAO** | Not Depicted | Not Depicted | Not Depicted |
| | **FAA/NACO** |  Depicted on VFR charts only | Not Depicted | Not Depicted |
| | **Jeppesen** | Not Depicted |   |   |
| | **Lido** | Not Depicted | Not Depicted | Not depicted except where operationally required.<br>Symbol as for Danger Areas (D)<br>   |

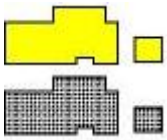
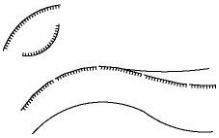
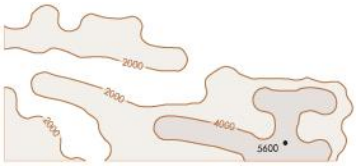
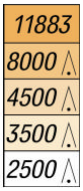
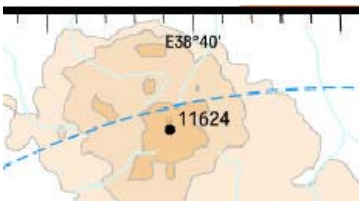
| | Manufacturer | Upper Control Area (UCA/UTA) | Warning Area (W) |
|---|---|---|---|
| Electronic Display Symbols | **Avidyne** | Not Depicted |  Lines and detail depicted vary by system. |
| | **Boeing** |  |  |
| | **Garmin** | Not Depicted |  |
| | **Honeywell** | Not Depicted | Not Depicted |
| | **L-3 Communications** | Not Depicted |  |
| | **Rockwell Collins** | Not Depicted | Not Depicted |
| | **Smiths** | Not Depicted | Not Depicted |
| | **Universal** | Not Depicted | Not Depicted |
| Chart Symbols | **ICAO** | Not Depicted | Not Depicted |
| | **FAA/NACO** |  |  |
| | **Jeppesen** |  |  |
| | **Lido** | UCA/UTA with respective text label of area concerned  | Same as Danger Area (D). Prefix W.  |

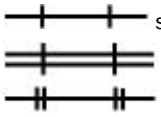
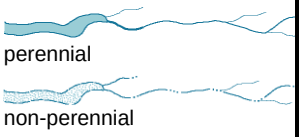
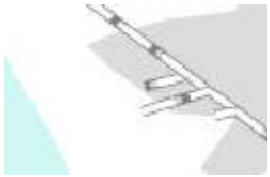
### *5.4 Zones*

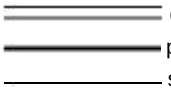
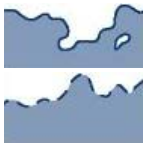
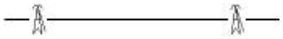
| | Manufacturer | Air Defense Identification Zones (ADIZ) | Air Traffic Zone (ATZ)/ Control Zone (CTR/CTZ) | Buffer Zone/Non-Free Flying Zone |
|---|---|---|---|---|
| Electronic Display Symbols | **Avidyne** |  | Not Depicted | Not Depicted |
| | **Boeing** |  | Not Depicted | Not Depicted |
| | **Garmin** |  | Depicted; Image not available | Not Depicted |
| | **Honeywell** | Not Depicted | Not Depicted | Not Depicted |
| | **L-3 Communications** | Not Depicted | Not Depicted | Not Depicted |
| | **Rockwell Collins** | Not Depicted |  | Not Depicted |
| | **Smiths** | Not Depicted | Not Depicted | Not Depicted |
| | **Universal** | Not Depicted | Not Depicted | Not Depicted |
| Chart Symbols | **ICAO** |  |  | Not Depicted |
| | **FAA/NACO** |  | Now called Class D |  |
| | **Jeppesen** |  |  | Not Depicted |
| | **Lido** |  | RFCs:<br>  <br>Terminal charts:<br>Not Provided, except defined as Class A, B, C, or D airspace. | Not Depicted |

| | Manufacturer | Helicopter Traffic Zone (HTZ)/Helicopter Protected Zone (HPZ) | Military Control Zone (MCTR)/Military Air Traffic Zone (MATZ) | Special Rules Area/Zone (SRA/SRZ) |
|---|---|---|---|---|
| Electronic Display Symbols | **Avidyne** | Not Depicted | Not Depicted | Not Depicted |
| | **Boeing** | Not Depicted | Not Depicted | Not Depicted |
| | **Garmin** | Not Depicted | Not Depicted | Not Depicted |
| | **Honeywell** | Not Depicted | Not Depicted | Not Depicted |
| | **L-3 Communications** | Not Depicted | Not Depicted | Not Depicted |
| | **Rockwell Collins** | Not Depicted | Not Depicted | Not Depicted |
| | **Smiths** | Not Depicted | Not Depicted | Not Depicted |
| | **Universal** | Not Depicted | Not Depicted | Not Depicted |
| Chart Symbols | **ICAO** | Not Depicted | Not Depicted | Not Depicted |
| | **FAA/NACO** | Not Depicted | Not Depicted |  Depicted on VFR charts only |
| | **Jeppesen** | Not Depicted |   | Not Depicted |
| | **Lido** | Not Depicted | Not Depicted |   |

## *5.5 Geographical Features*

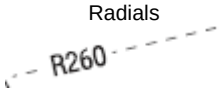
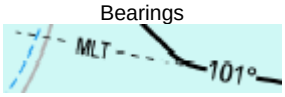
| | Manufacturer | Bluff | City pattern | Contours |
|---|---|---|---|---|
| Electronic Display Symbols | **Avidyne** | Not Depicted | Not Depicted | Not Depicted |
| | **Boeing** | Not Depicted | Not Depicted | Not Depicted |
| | **Garmin** | Not Depicted | Small City<br>Medium City<br>Large City | Not Depicted |
| | **Honeywell** | Not Depicted | Not Depicted | Not Depicted |
| | **L-3 Communications** | Not Depicted | Not Depicted | Not Depicted |
| | **Rockwell Collins** | Not Depicted | Not Depicted | Not Depicted |
| | **Smiths** | Not Depicted | Not Depicted | Not Depicted |
| | **Universal** | Not Depicted | Not Depicted | Not Depicted |
| Chart Symbols | **ICAO** |  |  |  |
| | **FAA/NACO** |  <br>Depicted on VFR charts only |  <br>Depicted on VFR charts only |  |
| | **Jeppesen** |  |  |  |
| | **Lido** | Not Depicted |  | Up to 6 contour layers shown in Terminal Charts<br>  <br>Each layer is separated by a contour line<br>Example:<br>  |

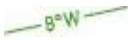
| | Manufacturer | Lake or Pond | Railroad (single or multiple track) | River or Stream |
|---|---|---|---|---|
| Electronic Display Symbols | Avidyne |  | Not Depicted |  |
| | Boeing | Not Depicted | Not Depicted | Not Depicted |
| | Garmin |  |  |  |
| | Honeywell |  | Not Depicted |  |
| | L-3 Communications |  | Not Depicted |  |
| | Rockwell Collins |  | Not Depicted |  |
| | Smiths | Not Depicted | Not Depicted | Not Depicted |
| | Universal | Not Depicted | Not Depicted | Not Depicted |
| Chart Symbols | ICAO |  perennial  non-perennial |  single 2 or more |  perennial non-perennial |
| | FAA/NACO |  perennial  non-perennial Depicted on VFR charts only |  single double 3 tracks more than 2 Depicted on VFR charts only |  perennial non-perennial Depicted on VFR charts only |
| | Jeppesen |  |  |  |
| | Lido |  |  Depicted on Visual Approach Charts (VACs) only |  |

| | Manufacturer | Road (single or multi-lane) | Shoreline | Telephone or Power Lines |
|---|---|---|---|---|
| Electronic Display Symbols | **Avidyne** |  |  | Not Depicted |
| | **Boeing** | Not Depicted | Not Depicted | Not Depicted |
| | **Garmin** |  |  | Not Depicted |
| | **Honeywell** | Not Depicted | Not Depicted | Not Depicted |
| | **L-3 Communications** |  | Not Depicted | Not Depicted |
| | **Rockwell Collins** | Not Depicted |  | Not Depicted |
| | **Smiths** | Not Depicted | Not Depicted | Not Depicted |
| | **Universal** | Not Depicted | Not Depicted | Not Depicted |
| Chart Symbols | **ICAO** |  dual highway<br>primary<br>secondary |  reliable<br>unreliable |  |
| | **FAA/NACO** |  dual lane<br>primary<br>secondary<br>Depicted on VFR charts only |  |  Depicted on VFR charts only |
| | **Jeppesen** |  |  |  |
| | **Lido** |  Depicted on Visual Approach Charts (VACs) only |  | Not Depicted |

| Manufacturer | Other Symbols | | | | |
|---|---|---|---|---|---|
| | City | Interstate Highway | State Highway | US Highway | National Highway |
| Garmin |  |  |  |  |  |

### *5.6 Other Lines*

| | Manufacturer | Country (State) Boundary | Formation Radial or Bearing (Enroute & Terminal) | International Date Line |
|---|---|---|---|---|
| Electronic Display Symbols | **Avidyne** |  | Not Depicted | Not Depicted |
| | **Boeing** | Not Depicted | Not Depicted | Not Depicted |
| | **Garmin** |  | Not Depicted | Not Depicted |
| | **Honeywell** |  | Not Depicted | Not Depicted |
| | **L-3 Communications** |  | Not Depicted | Not Depicted |
| | **Rockwell Collins** |  | Not Depicted | Not Depicted |
| | **Smiths** | Not Depicted | Not Depicted | Not Depicted |
| | **Universal** | Not Depicted | Not Depicted | Not Depicted |
| Chart Symbols | **ICAO** |  | Not Depicted | Not Depicted |
| | **FAA/NACO** |  |  |  |
| | **Jeppesen** |  |  |  |
| | **Lido** |  | Radials<br>  <br>Bearings<br>  | Not Depicted |

| | Manufacturer | Isogonic Lines | Time Zone Boundary |
|---|---|---|---|
| Electronic Display Symbols | **Avidyne** | Not Depicted | Not Depicted |
| | **Boeing** | Not Depicted | Not Depicted |
| | **Garmin** | Not Depicted | Not Depicted |
| | **Honeywell** | Not Depicted | Not Depicted |
| | **L-3 Communications** | Not Depicted | Not Depicted |
| | **Rockwell Collins** | Not Depicted | Not Depicted |
| | **Smiths** | Not Depicted | Not Depicted |
| | **Universal** | Not Depicted | Not Depicted |
| Chart Symbols | **ICAO** |   | Not Depicted |
| | **FAA/NACO** |   |   |
| | **Jeppesen** |   | +7 = UTC<br><br>+8 = UTC |
| | **Lido** |   | Not Depicted |

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# Appendix A. Manufacturer Notes Regarding Symbology

- Airbus
  a. Symbol selection philosophy: Design constraints may exist on avionics integrated displays, so human factors assessments, as recommended by the FAA and the European Aviation Safety Agency (EASA), are used to tailor symbology to its content and its context. A very detailed VOR symbol may be appropriate on a paper chart for use by a light aviation aircraft, where the small embedded compass is operationally interesting, and irrelevant on an integrated navigation display where simplicity (for graphical performance) and compatibility with other symbols (for operational use) will be of superior importance. As an example, waypoint or airport symbols on Airbus aircraft today are modified (display condition, color coding) to convey information on the trajectory or guidance mode of the aircraft. Runway symbol also changes once the landing runway is known by the system, and depending on the selected range.
  b. The Airbus A380 EFB hosts electronic charts from LIDO or Jeppesen (depending on the customer). Menus, wording, and colors are tailored to suit the customer's needs, but the symbols themselves are unchanged.
- Honeywell symbols in this document reflect those shown on Honeywell business/regional aircraft. For some symbol types, two symbols are provided; in these cases, the second symbol is an alternate symbol used on some applications. The symbols provided by Honeywell are intended to be general representations. Actual symbols and fonts may vary somewhat from application to application. Color will vary to conform to the flight deck color philosophy of the individual application. The symbols provided do not reflect what is shown on Bendix/King applications.
- Rockwell Collins symbols in this document reflect those shown on Rockwell Collins business/regional aircraft. Rockwell Collins does not differentiate between compulsory/on-request and fly-by vs. fly over navigational aid symbology.
- NACO notes many cases where a symbol is used on charts for flying under both Instrument Flight Rules (IFR) and Visual Flight Rules (VFR). For these symbols, the IFR version is depicted in this document.

# Appendix B. Definitions for Lines and Linear Patterns

This Appendix primarily provides definitions for lines and linear patterns that represent areas/regions and zones. One general airspace element is included – a "Special VFR NA (fixed wing)" airspace. These airspace and boundary elements may be less common, and in fact, some exist only in certain countries or regions.

Definitions were identified through a variety of sources. The Volpe Center worked with members of the SAE G-10 Aeronautical Charting Committee to identify key references. Additionally, the International Civil Aviation Organization (ICAO) provided a glossary of terms, and Jeppesen-Sanderson, Inc. searched through various State Aeronautical Information Publications (AIPs). Definitions were extracted verbatim from the source. In some cases, text was edited so that the definition would apply more generally. For example, some definitions include lateral and vertical dimensions for an airspace or boundary, but these dimensions may not be applicable worldwide and are thus omitted here.

The source for each definition is indicated next to the item; a list of sources is provided at the end of this Appendix. Excerpted definitions are identified accordingly in the source. An FAA definition was used when possible. When no FAA definition existed, an ICAO definition was used. When neither was available, Jeppesen-Sanderson Inc. either provided a State's AIP definition or composed a definition that reflected their understanding of the particular airspace type and its usage. The definitions below are intended for general reference only; they are not an endorsement of any particular source nor do they represent a world-wide definition. The definition provided by one State may differ slightly from that of another State, and no attempt was made to compare the definitions.

Definitions for three areas/regions that are not depicted in the industry survey are included in this Appendix for completeness. Two are elements that are similar to areas/regions that are addressed in the industry survey: an *advisory area*, which is similar to a training area, and a *military terminal control area (MTCA)* which is equivalent to a civilian terminal control area (CTA). The third is a *controlled firing area*, which was originally included in the list of lines and linear elements identified for inclusion in the survey. However, the FAA Aeronautical Information Manual (AIM) notes that, "There is no need to chart CFAs since they do not cause a nonparticipating aircraft to change its flight path" (AIM Pilot/Controller Glossary, Paragraph 3-4-7). In fact, none of the avionics manufacturers or aeronautical chart providers submitted a line or linear pattern for this element.

| **Airspace and Boundary** | **Definition** |
|---|---|
| Advisory Areas (Canada)* | Airspace of defined dimensions within which a high volume of pilot training or an unusual type of aerial activity may be carried out.<br>*Source: Transport Canada, Designated Airspace Handbook* |
| Air Defense Identification Zones (ADIZ) | The area of airspace over land or water, extending upward from the surface, within which the ready identification, the location, and the control of aircraft are required in the interest of national security.<br>*Source: AIM Pilot/Controller Glossary* |
| Air Route Traffic Control Center (ARTCC) | A facility established to provide air traffic control service to aircraft operating on IFR flight plans within controlled airspace and principally during the en route phase of flight. When equipment capabilities and controller workload permit, certain advisory/assistance services may be provided to VFR aircraft.<br>*Source: AIM Pilot/Controller Glossary* |

* Not included in industry review.

| Airspace and Boundary | Definition |
|---|---|
| Air Traffic Zone/Aerodrome Traffic Zone (ATZ) | An ATZ is an area of airspace that is established around civil and military airfields. Aircraft within an ATZ must obey the instructions of the tower controller (if present), or must make radio contact with the Information Officer or Air/Ground radio unit on the airport before entering the zone (in the case of an uncontrolled airfield), or must obey ground signals if non-radio.<br>*Source: Excerpted from United Kingdom AIP* |
| Airport Radar Service Area (ARSA) | This term is no longer in use. It was previously used for what is now known as Class C airspace. |
| Alert Areas (A) | Airspace which may contain a high volume of pilot training activities or an unusual type of aerial activity, neither of which is hazardous to aircraft. Alert Areas are depicted on aeronautical charts for the information of nonparticipating pilots. All activities within an Alert Area are conducted in accordance with Federal Aviation Regulations, and pilots of participating aircraft as well as pilots transiting the area are equally responsible for collision avoidance.<br>*Source: AIM Pilot/Controller Glossary (Special Use Airspace). See also AIM, Paragraph 3-4-6* |
| Altimeter Setting Regions (QFE/QNH) | QNE- The barometric pressure used for the standard altimeter setting (29.92 inches Hg.).<br>QNH- The barometric pressure as reported by a particular station.<br>*Source: AIM Pilot/Controller Glossary* |
| Balloon Launch Area | Airspace of defined dimensions within which a high volume of balloon launch or related aerial activity may be carried out.<br>*Source: Jeppesen* |
| Buffer Zone/Non-Free Flying Zone | A military term which describes airspace of defined dimensions, established in an area of political unrest, international conflict, or a war zone within which civilian aircraft are not permitted to operate without prior permission of the controlling military authorities.<br>*Source: Jeppesen* |
| Caution Areas | An airspace of defined dimensions within which uncontrolled and maneuvering aircraft may be encountered, so it is necessary for the pilots to use caution when entering such airspace for avoidance of danger. Pilots of participating aircraft as well as pilots transiting the area are responsible for collision avoidance and pilots transiting Caution Areas should coordinate with Air Traffic Service (ATS) units prior to entering such areas.<br>*Source: Islamic Republic of Iran AIP* |
| CNS/ATM Equipment Requirement Areas (e.g. ADS-B, RVSM, MNPS, RNP, etc.) | Airspace of defined dimensions, independent from any other airspace area, where specific equipment requirements related to aircraft Communications, Navigation, Surveillance, and Air Traffic Management systems have been established by the appropriate Air Traffic Service (ATS) authority or Air Traffic Control (ATC) unit.<br>*Source: Jeppesen* |
| Control Area (CTA/CTL) | A controlled airspace extending upwards from a specified limit above the earth.<br>*Source: ICAO International Civil Aviation Vocabulary* |

| Airspace and Boundary | Definition |
|---|---|
| Control Zone (CTZ/CTR) | A controlled airspace extending upwards from the surface of the earth to a specified upper limit.<br>*Source: ICAO International Civil Aviation Vocabulary* |
| Controlled Firing Area (CFA) (United States)* | Airspace wherein activities are conducted under conditions so controlled as to eliminate hazards to nonparticipating aircraft and to ensure the safety of persons and property on the ground.<br>*Source: AIM Pilot/Controller Glossary (Special Use Airspace). See also AIM Paragraph 3-4-7* |
| Danger Areas (D) | An airspace of defined dimensions within which activities dangerous to the flight of aircraft may exist at specified times.<br>*Source: ICAO International Civil Aviation Vocabulary* |
| Flight Information Region (FIR) | An airspace of defined dimensions within which Flight Information Service and Alerting Service are provided.<br>*Source: AIM Pilot/Controller Glossary* |
| Helicopter Protected Zone (HPZ) | A non-controlled airspace of defined dimensions extending upwards from sea level to a specified upper limit. An HPZ is established in order to indicate frequent helicopter activity in the area.<br>*Source: Excerpted from Norway AIP* |
| Helicopter Traffic Zone (HTZ) | A non-controlled airspace of defined dimensions extending upwards from sea level to a defined upper limit. A HTZ is established around an offshore installation with landing pad. An HTZ is established in order to indicate the performance of helicopter approach and departures.<br>*Source: Excerpted from Norway AIP* |
| Military Air Traffic Zone (MATZ) | At certain military aerodromes, Military Aerodrome Traffic Zones (MATZ) have been established for the increased protection of arriving, departing and circuit traffic. Additional mandatory Air Traffic Control (ATC) requirements are invariably specified for military pilots. The purpose of the MATZ is to provide a volume of airspace within which increased protection may be given to aircraft in the critical stages of circuit, approach and climb-out.<br>*Source: United Kingdom AIP* |
| Military Control Zone (MCTR) | See Military Air Traffic Zone (MATZ). |
| Military Operations Area (MOA) | A MOA is airspace established outside of Class A airspace area to separate or segregate certain nonhazardous military activities from IFR traffic and to identify for VFR traffic where these activities are conducted.<br>*Source: AIM Pilot/Controller Glossary (Special Use Airspace). See also AIM Paragraph 3-4-5* |

* Not included in industry review.

| Airspace and Boundary | Definition |
|---|---|
| Military Terminal Control Area (MTCA)* | Controlled airspace of defined dimensions normally established in the vicinity of a military aerodrome and within which special procedures and exemptions exist for military aircraft.<br>*Source: Canada Flight Supplement* |
| National Security Area (NSA) (United States) | National Security Areas consist of airspace of defined vertical and lateral dimensions established at locations where there is a requirement for increased security and safety of ground facilities. Pilots are requested to voluntarily avoid flying through the depicted NSA. When it is necessary to provide a greater level of security and safety, flight in NSAs may be temporarily prohibited by regulation under the provisions of 14 CFR Section 99.7. Regulatory prohibitions will be issued by System Operations, System Operations Airspace and AIM Office, Airspace and Rules, and disseminated via NOTAM. Inquiries about NSAs should be directed to Airspace and Rules.<br>*Source: AIM 3-5-7* |
| Oceanic Control Area (OCA) | Airspace over the oceans of the world, considered international airspace, where ICAO oceanic separation and procedures are applied. Responsibility for the provisions of air traffic control service in this airspace is delegated to various countries, based generally upon geographic proximity and the availability of the required resources.<br>*Source: Jeppesen* |
| Positive Control Area (PCA) | Any aircraft shall, under instrument meteorological conditions, be flown in accordance with instrument flight rules within an air traffic control area or an air traffic control zone, and not fly in any other airspace.<br>*Source: Japan AIP (referencing Civil Aeronautics Law)* |
| Prohibited Airspace Area (P) | Airspace designated under 14 CFR Part 73 within which no person may operate an aircraft without the permission of the using agency.<br>*Source: AIM Pilot/Controller Glossary (Special Use Airspace). See also AIM Paragraph 3-4-2* |
| Restricted Airspace Area (R) | Airspace designated under 14 CFR Part 73, within which the flight of aircraft, while not wholly prohibited, is subject to restriction. Most restricted areas are designated joint use and IFR/VFR operations in the area may be authorized by the controlling ATC facility when it is not being utilized by the using agency. Restricted areas are depicted on en route charts. Where joint use is authorized, the name of the ATC controlling facility is also shown.<br>*Source: AIM Pilot/Controller Glossary (Special Use Airspace). See also AIM Paragraph 3-4-3* |
| Special Rules Area/Zone (SRA/SRZ) | Controlled airspace within which special rules and procedures are prescribed and published for the protection of IFR flights from VFR flights.<br>*Source: Excerpted from Austria AIP* |

* Not included in industry review

| Airspace and Boundary | Definition |
|---|---|
| Special VFR NA (Fixed Wing) Airspace (United States) | Airspace associated with Class B terminal airspace areas where Air Traffic Control (ATC)-approved special VFR clearances are not authorized (i.e., no special clearances for VFR aircraft when weather conditions are less than basic VFR weather minima).<br>*Source: Jeppesen* |
| Speed Limit Area | Airspace of defined dimensions, independent from any other airspace area, where specific aircraft speed limits have been established by the appropriate Air Traffic Service (ATS) authority or Air Traffic Control (ATC) unit.<br>*Source: Jeppesen* |
| Temporary Flight Restriction Area (TFR) | A TFR is a short-term airspace restriction in a limited geographical area, typically used in the United States. TFRs are generally established to restrict flight over major sporting events, natural disaster areas, air shows, space launches, and during Presidential movements. More information can be found in AIM Paragraph 3-5-3. |
| Temporary Reserve/ Segregated Areas (TRA) | A Temporary Reserved Area (TRA) is a defined volume of airspace normally under the jurisdiction of one aviation authority and temporarily reserved, by common agreement, for the specific use by another aviation authority and through which other traffic may be allowed to transit under an Air Traffic Service (ATS) authority.<br>*Source: Excerpted from United Kingdom AIP* |
| Terminal Control Area (TCA/TMA) | A control area normally established at the confluence of Air Traffic Service (ATS) routes in the vicinity of one or more major aerodromes.<br>*Source: ICAO International Civil Aviation Vocabulary*<br>Note: In the United States, Class B airspace has replaced the term TCA. |
| Terminal Radar Service Area (TRSA) | Airspace surrounding designated airports wherein ATC provides radar vectoring, sequencing, and separation on a full-time basis for all IFR and participating VFR aircraft. The AIM contains an explanation of TRSA. TRSAs are depicted on VFR aeronautical charts. Pilot participation is urged but is not mandatory.<br>*Source: AIM Pilot/Controller Glossary. See also AIM Paragraph 3-5-6* |
| Traffic Information Area/Zone (TIA/TIZ) | Traffic information areas (TIA) and traffic information zones (TIZ) are established at airports where the traffic is relatively light and therefore only Aerodrome Flight Information Service (AFIS) is provided. AFIS units do not issue clearances. The responsibility for avoiding collisions solely rests with the pilot when flying in to or out from these airports. The AFIS unit will state the runway in use, weather and traffic situation considered.<br>*Source: ICAO International Civil Aviation Vocabulary* |
| Training Areas | Airspace of defined dimensions within which a high volume of pilot training or an unusual type of aerial activity may be carried out.<br>*Source: Jeppesen* |

| Airspace and Boundary | Definition |
|---|---|
| Upper Control Area (UCA/UTA) | Controlled airspace established by an appropriate Air Traffic Service (ATS) authority or Air Traffic Control (ATC) unit, of defined dimensions and between upper altitude limits, which exists above terminal airspace area(s) where the terminal ATC unit also has responsibility for control of aircraft operating within the designated upper airspace. An Upper Control Area (UCA) is not associated with an airport. An Upper Terminal Area (UTA) is associated with an airport.<br>*Source: Jeppesen* |
| Warning Areas | A warning area is airspace of defined dimensions extending from 3 nautical miles outward from the coast of the United States, that contains activity that may be hazardous to nonparticipating aircraft. The purpose of such warning area is to warn nonparticipating pilots of the potential danger. A warning area may be located over domestic or international waters or both.<br>*Source: AIM Pilot/Controller Glossary (Special Use Airspace). See also AIM Paragraph 3-4-4* |

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| Boeing | www.boeing.com |
| Garmin | www.garmin.com |
| Honeywell | www.honeywell.com |
| L-3 Communications | www.l-3com.com |
| Rockwell Collins | www.rockwellcollins.com |
| Smiths | www.smiths-aerospace.com |
| Universal Avionics | www.universalavionics.com |

| Chart Providers | Website |
|---|---|
| ICAO | www.icao.int |
| FAA/NACO | www.naco.faa.gov |
| Jeppesen | www.jeppesen.com |
| Lido | www.lhsystems.com |

| Reference documents | Website |
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| Volpe Center research reports | www.volpe.dot.gov/hf/pubs.html |
| FAA policy documents | www.faa.gov, under the Regulations and Policies section |

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