AIRSPACE EXPLAINED

Airspace is an area of aeronautical knowledge that is commonly poorly demonstrated on airman practical tests. Even when airman applicants demonstrate knowledge of the airspace system that meets the minimum standard necessary for issuance on an airman certificate or rating, it is usually clear that this knowledge level has been achieved as a result of rote learning (learning that is the result of simple memorization without understanding the underlying concepts). Consequently, it is not surprising that the pilot population is generally poorly informed on this subject. That observation is supported by the fact that airspace violations remain a major cause of certificate actions taken against offending members of the general aviation community. This article is designed to present the airspace system and its rules in terms of the logic that necessitates the existing rules. The resulting deeper understanding should allow aviators to exercise airspace knowledge at a more competent level, both during practical tests and throughout their flying careers.

The airspace system in the United States is categorized by letter classifications from **A** through **G**, with the omission of **F** (which does not exist in the U.S.). These classes of airspace are logically arranged with regard to the conditions each airman must meet to legally operate an aircraft in each airspace class. These requirements increase gradationally, with Class G Airspace being the least restrictive, to Class A Airspace, the most restrictive airspace.

Separation of Traffic

Separation of air traffic, and the methods of separation, is the key to the organization of the airspace system. Consequently, understanding these separation concepts is crucial to complete understanding of this subject.

Aircraft that are being operated under Instrument Flight Rules (IFR) are separated from other IFR aircraft by Air Traffic Control (ATC). ATC is charged with the responsibility to maintain a distance between these aircraft of (usually) five miles laterally, and 1000 feet vertically. These distances can be slightly decreased in some areas.

Aircraft that are being operated under Visual Flight Rules (VFR) are separated from all other aircraft visually. Pilots of these aircraft are charged with the responsibility of maintaining “see-and-avoid” vigilance as a collision avoidance technique. When an aircraft that is being operated under IFR is in visual meteorological conditions (VMC), the pilot of that aircraft is also required to maintain visual separation from other aircraft.

Class G Airspace

Despite popular perception, the federal aviation authorities do not regulate airspace unless there is a specific need to do so in the interest of safety. Class G Airspace is an illustration of that principle. Fundamentally, Class G Airspace, formerly known as *Uncontrolled Airspace*, is airspace where ***IFR operations are not normally allowed***. Since no IFR aircraft will be emerging from clouds without warning, VFR pilots are allowed to operate in **one statute mile** of visibility and are required to remain simply **clear of clouds** during daylight hours. The wisdom of operating visually in these conditions is questionable, so the weather minimums for night operations in Class G Airspace have been increased to 3 statute miles of visibility with cloud clearances of 500 feet below, 1000 feet above, and 2000 feet horizontally.

Originally, IFR was mostly confined to airlines and corporate aircraft, and IFR approaches were conducted only at the largest airports. The cost of equipment required for IFR flight was beyond the financial capabilities of the operators of most general aviation aircraft. Very few smaller airports had instrument approaches available. Under these conditions, Class G Airspace, originally called Uncontrolled Airspace, was the most common type of airspace. But in the past 30 years, the affordability of instrument equipment, both for aircraft and for airports, has led to a massive expansion of IFR operations. Consequently, Class G Airspace has shrunk dramatically. In most places in the United States, it is now only found underlying Class E Airspace (See **Figure 1**).

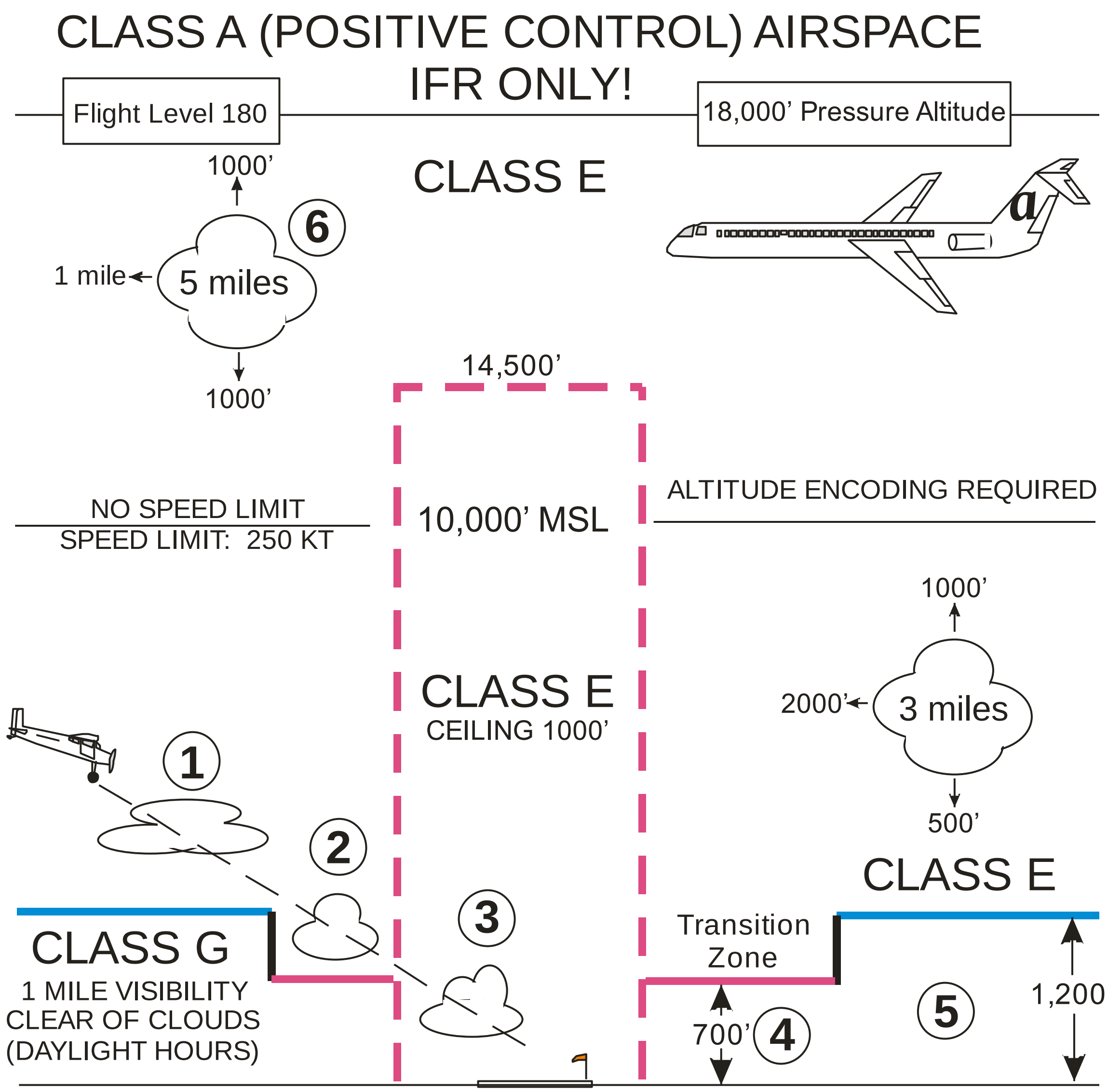

Figure 1

The aircraft on the left is executing an instrument approach to the airport at the center of the diagram. The instrument approach is designed to get the IFR aircraft close enough to the airport for the pilot to establish visual contact and land. The approach begins in Class E Airspace at an altitude above 1,200 feet AGL. Closer to the airport, the IFR aircraft requires a step-down to get within sight of the field. In this Transition Zone, the base of Class E Airspace is lowered to 700 feet AGL. Since the airspace system is designed to keep IFR aircraft from operating in Class G airspace, are allowed to operate in areas marked **4** and **5** while remaining clear of clouds in visibilities as low as one statute mile during daylight hours. Pilots operating under VFR in Class G Airspace after dark are required to remain 500 feet below clouds, 1000 feet above clouds, and 2000 feet horizontally from clouds while maintaining an inflight visibility of three statute miles. On the sectional aeronautical chart, Class G Airspace is depicted as shown on **Figure 2**.

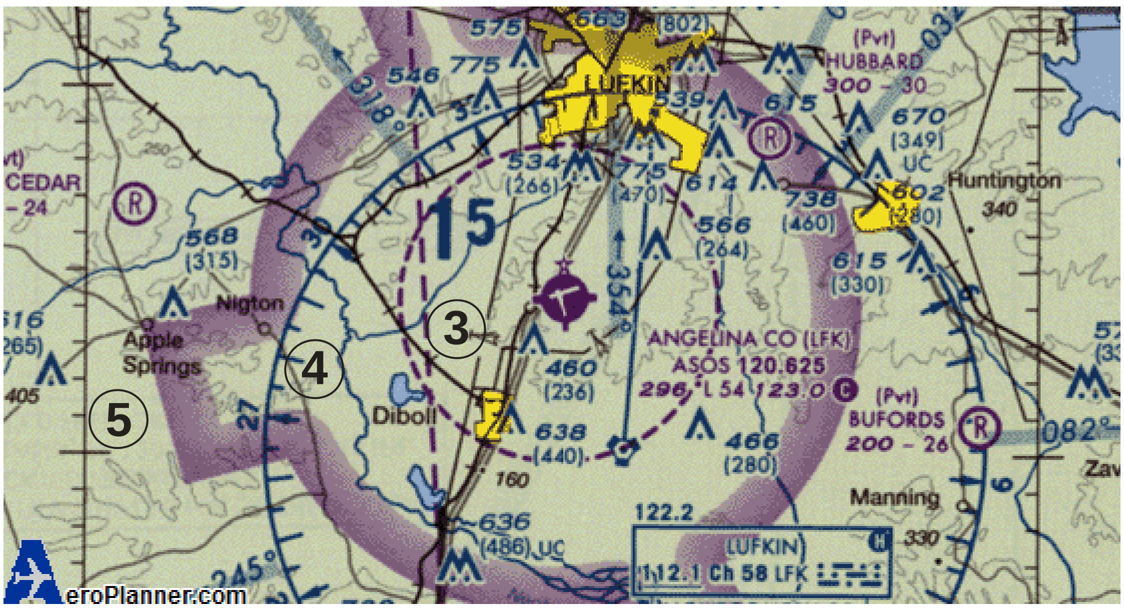

Figure 2

The magenta shaded area (**4**) represents the Transition Zone and encloses an area in which Class G Airspace extends from the surface up to 700 feet AGL. (Note that transitions zones *may* contain extensions to accommodate the requirements of instrument approach procedures.) Outside the shaded magenta line, area (**5**), Class G Airspace extends from the surface to 1,200 feet AGL. Area (**3**), which is enclosed by a dashed magenta line, depicts Class E airspace that extends all the way to the surface. The presence of this dashed magenta line, formerly called a *Control Zone,* indicates that this airport offers a *precision instrument approach*, which normally provides IFR separation down to 200 feet AGL.

Most general aviation airports offer only *non-precision* instrument approaches. These approaches only allow IFR aircraft to descend to minimum descent altitude that is approximately the same as the top of the transition zone. An example of this type of airport is depicted in **Figure 3**.

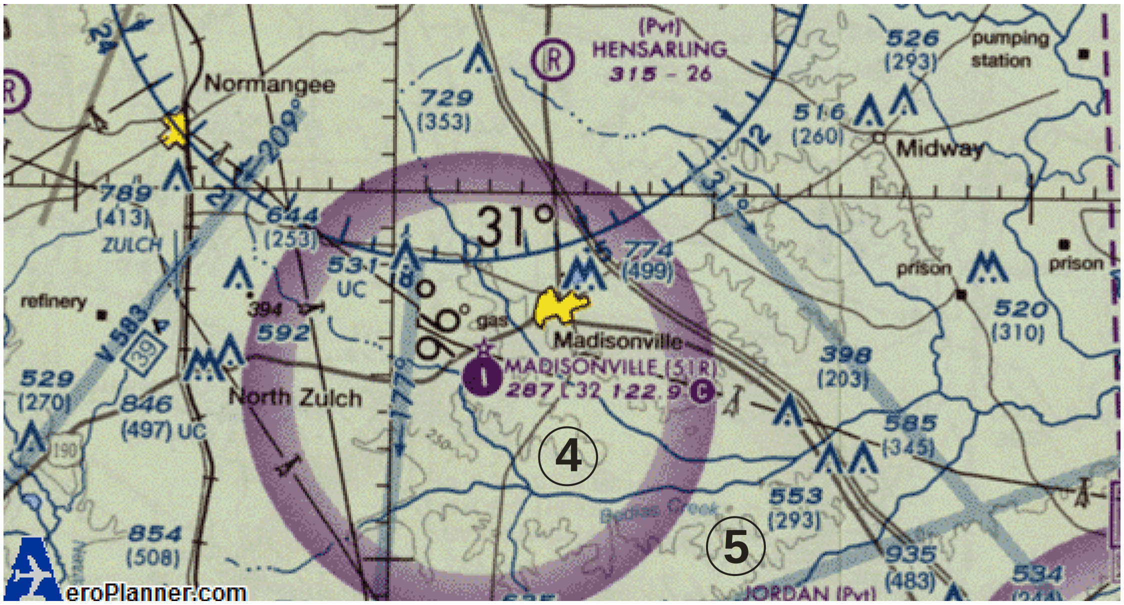

Figure 3

In this example, the Class G Airspace beneath the transition zone (area **3**) extends over the airport itself, allowing Class G flight operations at the airport.

There are still areas in the United States where Class G Airspace still exists at altitudes above 1,200 feet AGL. This occurs mainly in northwestern portion of the country, where population centers are smaller and more widely-scattered than in more densely-populated areas. Since IFR operations in these areas are limited, portions of that airspace do not require Class E protection. On the sectional chart, these areas are enclosed by a blue shaded boundary as shown in **Figure 4**.

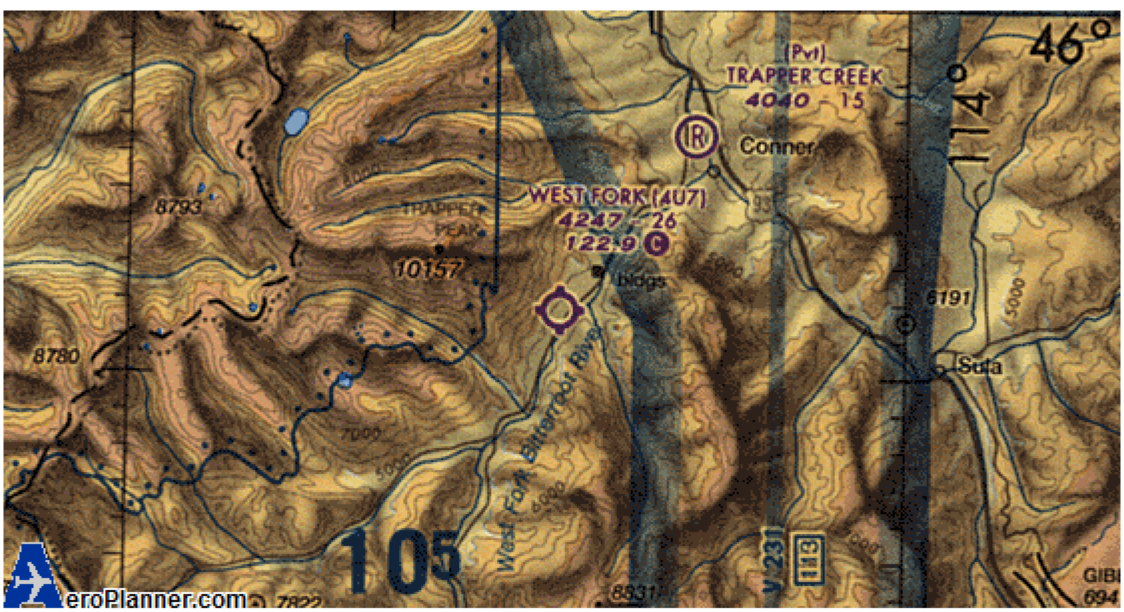

Figure 4

In this example from western Montana, the West Fork Airport lies in an area on the “sharp” side of the shaded blue line. In this area Class G Airspace extends from the surface to 14,500 feet MSL (the base of the *Continental Control Area*). In this airspace, pilots may conduct VFR flight operations in one statute mile visibility, while remaining clear of clouds, up to 10,000 feet MSL. Above that altitude, Class G Airspace weather minimums increase to one statute mile visibility, while remaining 500 feet below clouds, 1000 feet above clouds, and 2000 feet horizontally from clouds. Night minimums in Class G Airspace remain the same, regardless of altitude.

In summary, Class G Airspace is the least restrictive of all airspaces. VFR pilots are allowed to operate in weather conditions that would prevent legal VFR flight in all other airspaces. No communication with any entity is required, and no two-way communication equipment of any type is required to be installed in the aircraft. It is worth mentioning, however, that 14 CFR, Part 61, restricts inflight visibility in any airspace for student pilots to a minimum of 3 statute miles, so they are not fully enfranchised in Class G Airspace.

Class E Airspace

Class E Airspace requirements add a layer of restriction to those that define Class G Airspace. Most aviation occurs in Class E Airspace, formerly known as *Controlled Airspace*, and the rules for this airspace are written to provide separation between IFR and VFR aircraft.

As stated previously, ATC provides positive separation between all aircraft being operated under IFR. VFR pilots provide their own separation using see-and-avoid procedures. But a pilot operating under Instrument Flight Rules is not relieved of the responsibility of exercising see-and-avoid separation when weather conditions allow it. This becomes complicated when an IFR aircraft emerges from a cloud and suddenly transitions to visual separation. Both IFR and VFR pilots require some protection to increase their reaction time to deal with this transitional moment. Class E Airspace rules provide that protection. If a pilot operating an aircraft under VFR wants to share Class E Airspace with IFR aircraft, an inflight visibility of 3 statute miles must be maintained, and the aircraft must be flown no closer to clouds than 500 feet below, 1000 feet above, and 2000 feet horizontally. These rules must be observed when flying above the floor of Class E Airspace and below 10,000 feet MSL.

Consider the aircraft executing the instrument approach in **Figure 1**. Class E Airspace rules provide separation when it emerges from the cloud at area **1**. As the aircraft nears the vicinity of the airport, the floor of Class E Airspace is lowered so that separation protection is maintained when it flies out of the cloud at area **2**. If the instrument approach being flown is a non-precision approach, this is the approximate minimum descent altitude. If the aircraft is established on a precision instrument approach (which usually terminates at an altitude of 200 feet AGL), then Class E Airspace is extended to the surface so that the flight is protected when it emerges from the cloud at area **3**.

The dimensions of the *Control Zone*, where Class E Airspace exists at the surface (**Figure 3**, area **3**), is a 5 statute mile radius from the center of the airport, and vertically from the surface to 14,500 feet MSL. VFR flight within this *Control Zone* requires, in addition to the normal Class

E visibility and cloud clearances, a minimum ceiling of 1,000 feet (ceilings are always expressed in AGL).

At an altitude of 10,000 feet MSL, there is a fundamental change in airspace rules that necessitates a shift in Class E and Class G airspace visibilities and cloud clearances. Below 10,000 feet MSL, a speed limit of 250 knots is imposed on all aircraft flying in that airspace. Above 10,000 feet MSL, pilots of all aircraft are allowed to operate at any subsonic speed. Since high-performance IFR aircraft are emerging from clouds at much higher airspeeds (**Figure 1**, area **6**), Class E required inflight visibility is increased to 5 statute miles, and cloud clearances are increased to 1000 feet above and below clouds and 1 statute mile horizontally. (Class G visibility and cloud clearances are also increased, although no IFR aircraft should normally be operating in this airspace.)

In summary, Class E Airspace rules are more restrictive that those that govern Class G Airspace, but only in terms of required minimum visibilities and cloud clearances necessary to accommodate the separation of IFR and VFR aircraft. There is still no requirement for electronic communication or navigation equipment or its use. The only requirement of this type is the requirement of an altitude-encoding transponder for flight above 20,000 feet MSL.

Class D Airspace

Class D Airspace, formerly known as an *Airport Traffic Area*, adds a radio communication requirement to the meteorological rules of Class E Airspace. Class D Airspace is depicted on the Sectional Aeronautical Chart bounded by a segmented blue line, as shown in **Figure 5**. The symbol for the primary airport is blue in color, indicating the presence of a control tower. The VHF communication frequency for the control tower is displayed in the information data for the airport. Additional frequencies for the airport are found on the panel of the chart.

The standard radius of Class D Airspace is 5 statute miles (4.4 nautical miles), but it *may* include extensions to accommodate instrument approaches. The *standard* upper dimension of Class D Airspace is 2,500 feet AGL, but that may vary. This upper limit is displayed as a two-digit number, indicating the MSL altitude expressed in hundreds of feet, inside a segmented blue box within the segmented blue circle.

Figure 5

VFR aircraft entering Class D Airspace must be equipped VHF radios. The pilot must establish two-way radio communication with the tower controller *before* entering. The weather minimums for VFR flight are the same as those for the Class E *Control Zone*, minimum cloud clearance of 500 feet below, 1000 feet above, and 2000 feet horizontally from clouds, minimum inflight visibility of 3 statute miles, and a ceiling of at least 1,000 feet.

VFR flight within Class D Airspace *may* be conducted in less than the above weather minimums by requesting a *Special VFR* clearance from the tower controller. If that clearance is granted, a pilot may enter or leave Class D Airspace in 1 statute mile of visibility while remaining clear of clouds.

Many, but not all, control towers are equipped with radar. Where control towers are equipped with radar, controllers commonly assign discreet transponder codes to arriving and/or departing VFR aircraft. Because of this practice, it is tempting for pilots to consider a transponder as required equipment for VFR flight in Class D Airspace, but it is not.

Some Class D airports have sophisticated radar facilities and extensive approach and departure control policies. Planners expect a rapid expansion in air carrier activity, but the traffic levels at these airports do not yet justify formalized and mandatory approach and departure control procedures. These areas are called TRSA's or Terminal Radar Service Areas (formerly known as *Class I Terminal Control Areas (TCA's)*. They are depicted on the Sectional Aeronautical Chart as concentric dark gray circles surrounding a Class D airport (**Figure 6**). Although airports with TRSA's appear very impressive on the chart, they are still simple Class D airports. Participation in radar services at these airports is strictly on a voluntary basis, and VFR pilots may fly in these non-Class D areas without contacting ATC. However, when flying into or out of the primary airport in the TRSA, the tower controllers will "require" VFR pilots to contact approach or departure control and be issued a discreet transponder code.

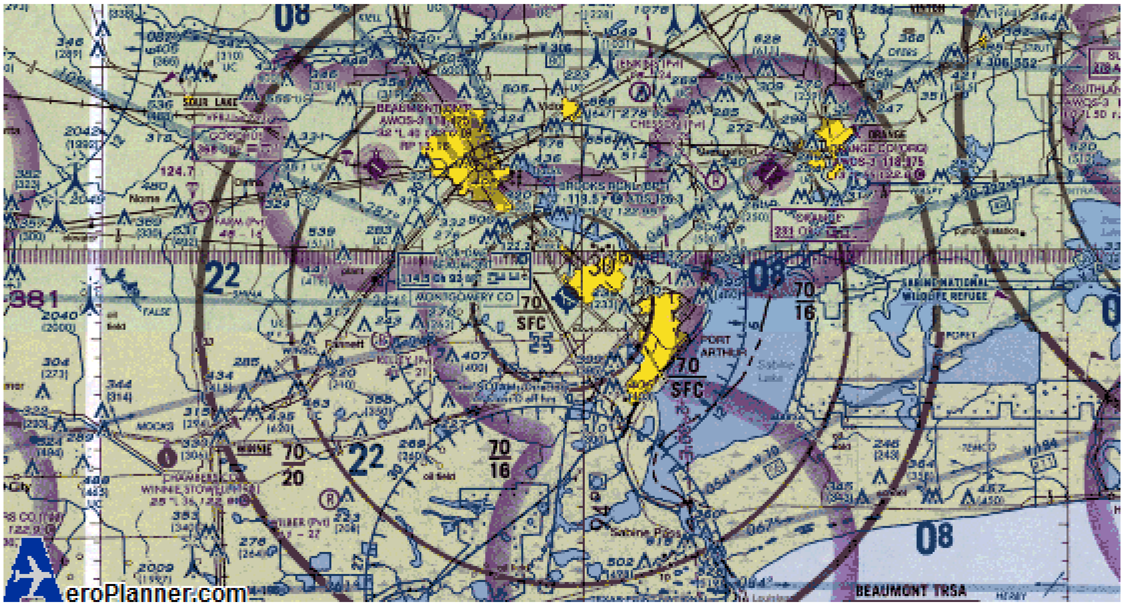

Figure 6

Although two-way radio communication is formally required for VFR flight in Class D Airspace, this requirement may be waived if prior permission is obtained. This permission is generally granted on a case-by-case basis, and regular operation without a radio is not normally allowed.

In summary, Class D Airspace is established at airports where air traffic is dense enough to justify a system of orderly sequencing of arriving and departing VFR and IFR aircraft. This sequencing may or may not be accomplished with the use of radar service.

Class C Airspace

Class C Airspace, formerly called *ARSA (Airport Radar Surveillance Area)*, and *Class II Terminal Control Areas* (TCA's), is established around airports whose traffic levels justify the mandatory use of radar to accomplish an orderly flow of inbound and outbound aircraft. The primary airports in Class C Airspaces usually accommodate a mix of general aviation traffic, moderate levels of air carrier traffic, and sometimes military traffic. The varied performances of the aircraft in this traffic mix require a somewhat intense effort by ATC to achieve a safe and efficient traffic flow.

Class C Airspace is depicted on the VFR Sectional Aeronautical Chart as a blue aerodrome symbol surrounded by two, concentric bold magenta circles, as shown in **Figure 8**. The inner circle is normally 5 nautical miles in radius, and the outer circle normally has a radius of 10 nautical miles. The surface area has a *standard* vertical extent of 1,500 feet, while the upper shelf extends from 1,500 feet AGL up to 4,000 feet AGL, as shown in **Figure 7**.

Aircraft operating in Class C Airspace are required to be equipped with two-way radio communication equipment and altitude-encoding transponders.

A VFR pilot who intends to operate inside Class C Airspace is required to maintain the same weather minimums that applied in Class E Airspace, and is required to establish two-way radio communication with ATC *before* entering. <u>Establishment</u> of two-way radio communication is clearly defined: the pilot will call ATC, and ATC will reply, using the aircraft call sign, and does not issue an instruction to "stand by" or "remain clear." If those conditions are met, the pilot may enter the Class C area.

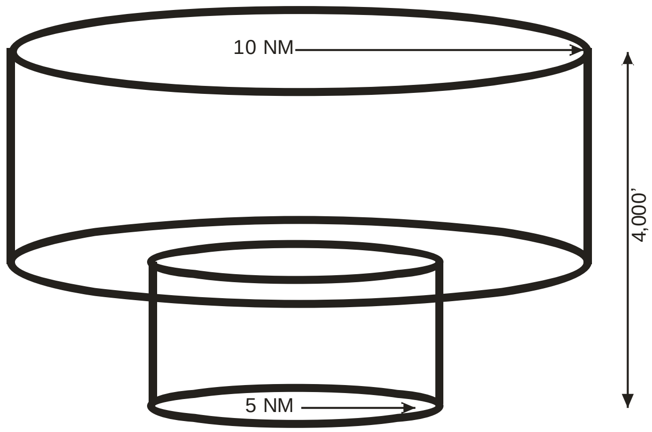

Figure 7

Note that no *specific* clearance is required for a VFR aircraft to enter Class C Airspace. In fact, controllers of Class C Airspace will avoid using the term "clearance" when dealing with VFR flights. If a VFR pilot presses the controller for a definite clearance into Class C, the pilot will be instructed to "maintain VFR." Also note that neither an altitude-encoding transponder nor two-way radio communication is required for VFR flight in the airspace beneath the upper shelf of this airspace. <u>However</u>, even though aircraft flying above the upper limit of Class C Airspace are not required to be in two-way radio communication with ATC, they <u>are</u> required to be equipped with an operating altitude-encoding transponder.

In summary, Class C Airspace is established at airports where the traffic, specifically air carrier traffic, is dense enough to *require* positive separation of all aircraft by means of radar services.

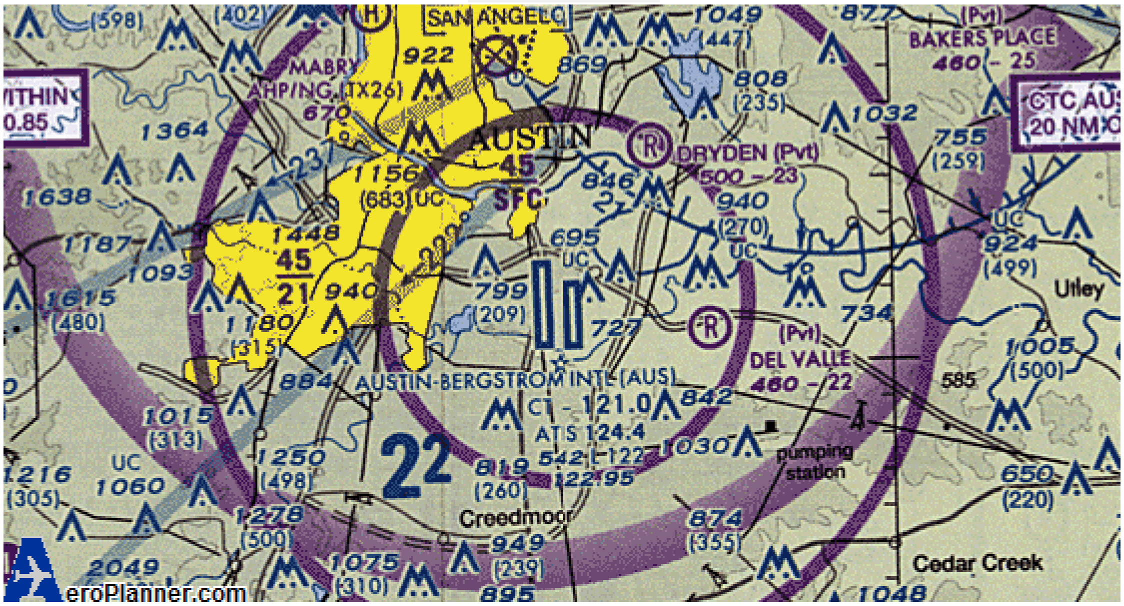

Figure 8

Class B Airspace

Class B Airspace, formerly called Class III TCA's (*Terminal Control Areas*), is established around the very busiest air carrier hubs. These areas have traffic intensities that are so intense that safety dictates that positive separation of aircraft be maintained through strict radar control. Additionally, the experience level of airmen operating in Class Bravo Airspace is heightened by limiting access to this airspace by student pilots.

Class B Airspace is depicted on the Sectional Aeronautical Chart as a series of concentric bold blue circles centered on one or more air carrier hub airports (**Figure 9**). The circles are often irregular, with extensions and other modifications added to accommodate the flight paths of arriving and departing air carrier traffic. The lateral extent of each shelf is indicated by a notation of the radius of that segment in nautical miles. It is interesting to note that these are *DME* distances, and not straight-line surface distances. Since the lateral boundaries of Class B Airspace are defined by DME values, the blue lines are concentric around the on-field Class T VOR at the hub airport. The upper and lower extents of each shelf segment are clearly marked in MSL altitude values.

Also depicted is a thin magenta line that roughly surrounds Class B Airspace. This line is labeled "Mode C", and indicates that aircraft operating within the area defined by this line (or Mode C "veil") are required to be equipped with operating altitude-encoding transponder equipment, even when flying below the floor of Class B Airspace segments. The magenta Mode

C line does not coincide with the blue Class B boundary lines because the Mode C veil is centered on the terminal control radar antenna, rather than on the VOR transmitter.

Also surrounding Class B Airspace on the Sectional Aeronautical Chart is a rectangular area formed by wide white lines. This symbol indicates the publication of an additional Terminal Area Chart that provides *much* more detail of this airspace. Additional information supplied on this chart includes DME values for the lateral boundaries of the Class B, standard landmarks to be used as reporting points when communicating with ATC, and approach control frequencies (and tower frequencies) necessary for establishing and maintaining contact with ATC. Since this information is *not* provided on the Sectional chart (or not provided in an easily-utilized format), it is strongly recommended that pilots operating in Class B Airspace possess and use the appropriate Terminal Area Charts.

VFR Pilots who intend to operate in Class B Airspace <u>must</u> contact ATC <u>before</u> entering, receive a discrete transponder code, and receive a <u>clearance</u> into or through Bravo Airspace. Pilots operating aircraft equipped with Mode C transponders who fail to comply with these requirements may be subject to certificate action for airspace violation. Pilots operating aircraft equipped with Mode S transponders who fail to comply with these requirements <u>will</u> be subject to certificate action for airspace violation.

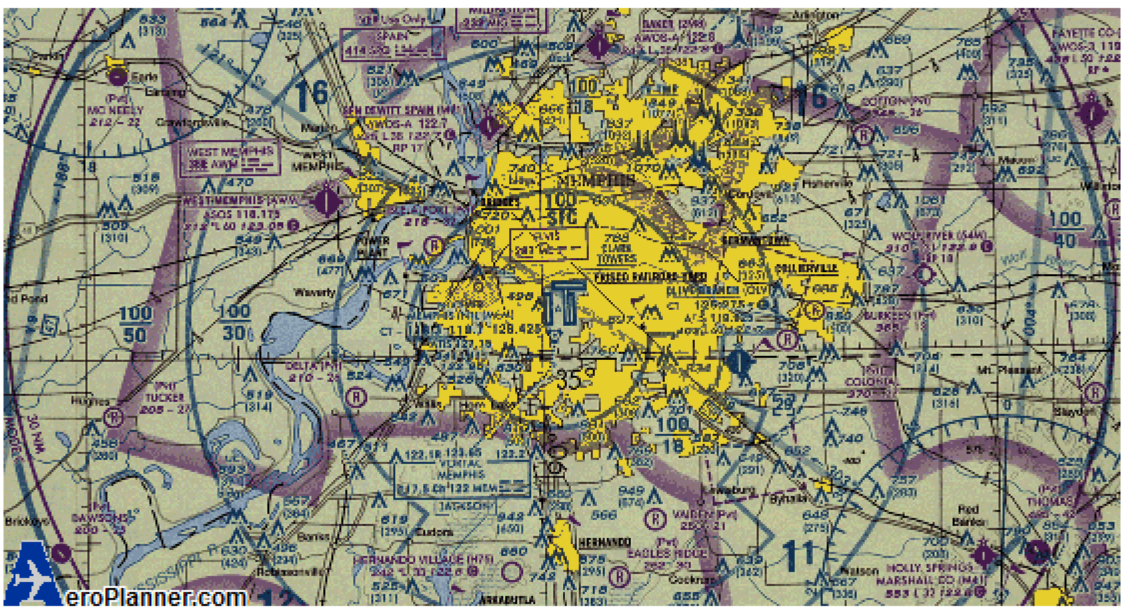

Figure 9

In summary, Class B Airspace is established at the nation's busiest air carrier hub airports where the traffic is extremely dense, and the increased requirement for aviation safety necessitates positive separation of all aircraft by means of strictly-applied radar services.

Class A Airspace

Class A Airspace, formerly known as *Positive Control Airspace*, occurs above Flight Level 180 (approximately 18,000 feet MSL), and it is the most restrictive class of airspace **(Figure 1)**.

Since only IFR flight is normally permitted at these altitudes, all IFR regulations must be met. Pilots of aircraft operating at these altitudes must be instrument rated, must be operating on an IFR flight plan, must have an IFR clearance, and must be flying an aircraft that is equipped and maintained to legally operate in IFR conditions. All aircraft operating above FL180 must have their altimeters set to standard atmospheric pressure, 29.92" Hg. Additional oxygen and equipment requirements apply to aircraft operating at various altitudes in Class A Airspace.

Class A Airspace is not depicted by any symbol on any chart, VFR or IFR.

In summary, Class A Airspace is established at altitudes where aircraft, primarily turbine-powered aircraft, cruise at airspeeds that require increased positive vertical and lateral separation for safe operation.

CONCLUSION

Airmen have struggled for generations to comprehend airspace rules. Applicants for airman ratings and certificates have traditionally dreaded practical testing of tasks requiring demonstration of knowledge of airspace elements. Consequently, performance in this area is consistently substandard. The results are poor performance practical tests and potential airspace violations and the resultant compromised flight safety and potential FAA certificate actions.

Hopefully, this presentation of airspace rules from the standpoint aircraft separation and the *logical* hierarchy of the airspace classes will affect a more complete understanding if this critical area of practical aviation knowledge.