



## ***MID-AIR COLLISION AVOIDANCE***



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Prepared in the interest of Aviation Safety by the  
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Mid-air Collision Avoidance (MACA) is a subject that is gaining heightened awareness among both civilian and military aviation communities. With increasing numbers of aircraft taking flight and many airports approaching gridlock, knowledge of air traffic and airfield operating procedures becomes more vital for pilots and aircrews. This pamphlet contains information on locally based aircraft operations, traffic patterns, arrival, and departure routes at Dover Air Force Base. The goal of the 436th Airlift Wing Flight Safety Office (436 AW/SEF) is to provide sufficient information to pilots and aircrew to enable recognition of potential mid-air collision hazards and help everyone enjoy a safe flying environment.

“See and avoid” is the proverb by which all aircrews must adhere regardless of operating IFR or VFR. In the local Dover airspace, large military aircraft tend to be relatively easy to see while smaller civilian aircraft tend to cause more difficulty in accurate visual acquisition. Nonetheless, it is everyone’s responsibility to visually scan for traffic at all times. Therefore, all aircraft transiting the Dover airspace are highly encouraged to use all available aircraft lighting, transponder, and Air Traffic Control (ATC) advisory services to the maximum extent possible.

The 436 AW/SEF is the Office of Primary Responsibility (OPR) for the development, publishing, and maintenance of the Dover AFB Mid-air Collision Avoidance (MACA) pamphlet. If you have any questions concerning information contained within this pamphlet, contact the 436 AW/SEF at (302) 677-2048 or Airfield Operations at (302) 677-3262.



## DOVER AFB

Dover Air Force Base is part of Air Mobility Command, a worldwide network of bases whose primary mission is transporting people and equipment. Our base is located 60 miles east of the Baltimore/Washington area, and 60 miles south of Philadelphia.

The base is home to the 436th Airlift Wing (Active Duty) and the 512th Airlift Wing (Reserves). Together, the wings operate the jumbo strategic airlift C-5M Super Galaxy and the dynamic airlift C-17A Globemaster III aircraft.

There are over 50 civilian airfields within a 60 mile radius of Dover AFB. Since Dover is the largest military aerial port on the East Coast, local air traffic is often congested. The types of aircraft transiting the Delmarva airspace range from home-built ultra lights to huge jumbo-jets to supersonic fighter aircraft.

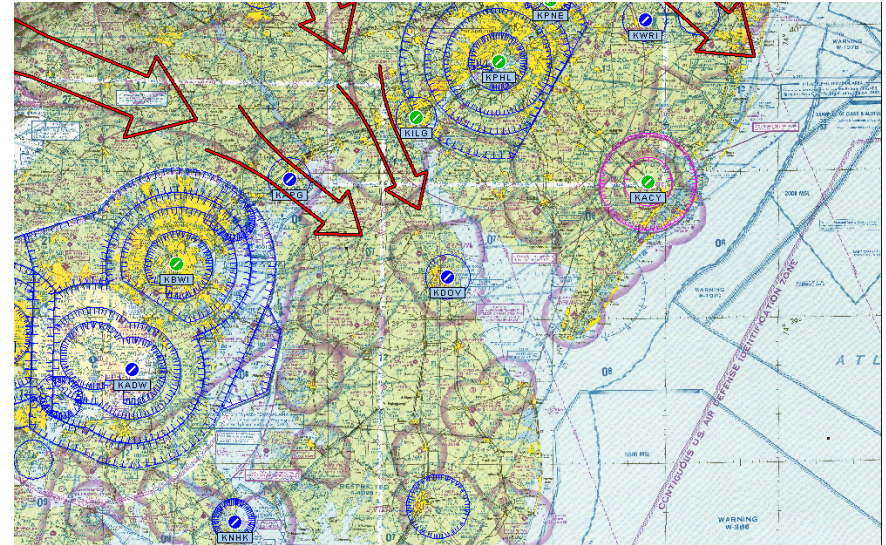
**BOTTOM LINE....**The potential for a mid-air collision is extremely high!



**C-172 after mid-air with C-150**

## DOVER AIRSPACE

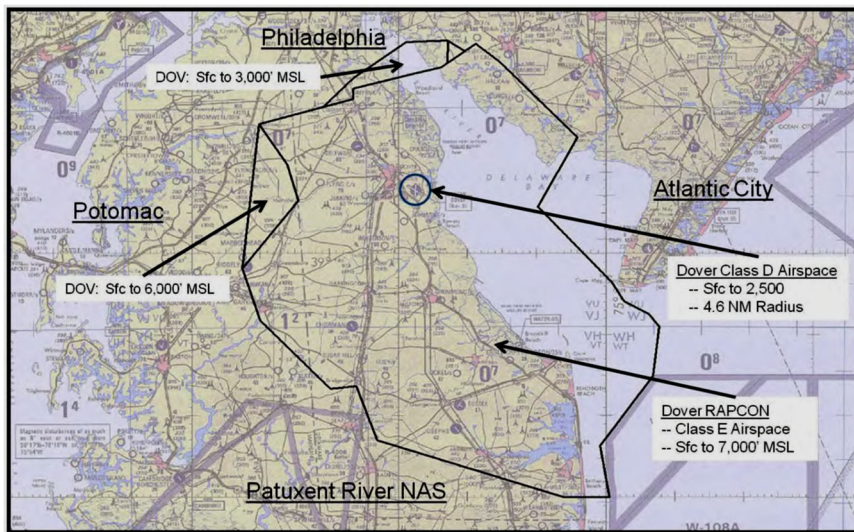
The airspace surrounding Philadelphia, Baltimore, and Washington DC is some of the busiest in the country. Dover's proximity to these areas brings a high volume of traffic through the Delmarva Peninsula and increases the chances of a mid-air collision.



## RADAR APPROACH AIRSPACE

Dover AFB provides radar control services to aircraft transiting the area shown on the following page for altitudes 7,000 ft and below. Above 8,000 ft, the airspace is controlled by Washington Center. The most congested area in our airspace is north of the base. Most VFR traffic passes north of Dover and south of Philadelphia. Arriving traffic landing runway 19 intercept the localizer at 1,700 feet MSL. Traffic departing runway 01 and runway 32 initially climbs to 3,000 feet MSL. Be cautious for arriving and departing traffic!





Dover Approach Control Airspace.

## DEPARTURES/ARRIVALS AND APPROACHES

Depicted on the following pages are the SID/STAR that IFR aircraft use to get in and out of Dover AFB. Primary departure arrival is typically radar vectors that avoid busy airspace (East over the water before turning North, Northwest to split BWI/PHL) Pilots use these during both IMC and VMC weather conditions. Numerous near mid-air collisions have taken place in this type of airspace and it requires considerable attention when transiting it. **Airspeeds will range up to 250 knots.**

CANNY 1 departure to the West



WNSTN 1 departure to the East

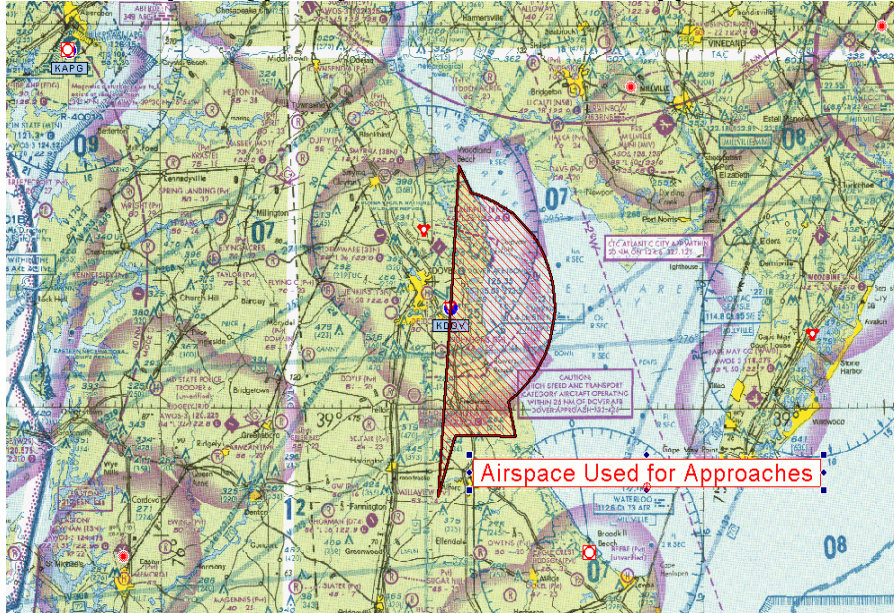


ARLFT 2 Arrival from West and Southwest





### Airspace typically used for instrument approaches



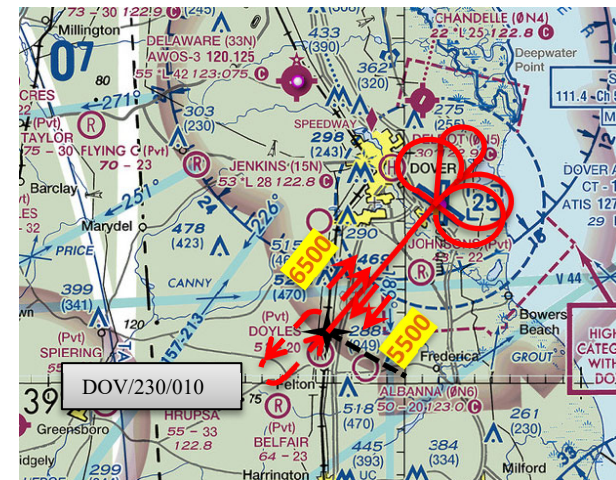
### DOVER CLASS D AIRSPACE



The base itself is surrounded by Class D airspace. Every aircraft **MUST** contact Dover tower (126.35) before entering this airspace. Since we all share the same sky, it is our duty to know about your flying operations and stay out of your way while letting you know about our activities.

The best way to avoid a mid-air collision is to stay alert and communicate your intentions to Dover Approach Control (132.425) and request flight following, especially if you plan to fly within 25NM of Dover AFB. Help us know where you are and where you're going. We monitor the same frequencies you do and we'll be looking and listening for you. If you intend on traversing the Class D airspace, establish and maintain two-way radio contact with Dover Tower (126.35) prior to entering the airspace.

Pilots should be alert for heavy C-5M and C-17A jet traffic when flying within 15 nautical miles of Dover AFB since extensive operations are conducted 24 hours a day, 7 days a week, every day of the year. Our normal traffic pattern is 3,000 feet MSL and below, however, we frequently fly non-standard VFR approaches to the airfield from altitudes as high as 6,500 feet MSL. Below is a depiction of the Wyoming departure/arrival track for local tactical training. Aircraft in the vicinity of DOV/230/010 should be especially vigilant as large military aircraft may be transiting altitudes frequently used by GA traffic.



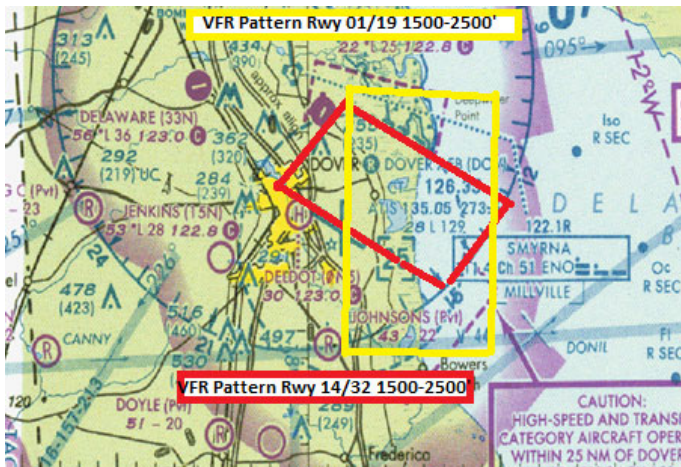
**VFR Wyoming Departure and Arrival Track**



Our traffic pattern is normally flown east of the airfield. IFR radar pattern altitude is usually 3,000 feet MSL, while our VFR traffic pattern is flown at 1,500 feet MSL.

In addition, C-17A formations of up to 4 aircraft with 1 minute separation may launch from Dover AFB. The elements will then rejoin and fly in one mile trail formation utilizing 500 feet altitude separation. It is very important that if you see one military aircraft, you should look out for others in formation.

Our crews use special call signs beyond just tail numbers (much like commercial aircraft). Training sorties use “JUMBO” or “HAGAR” for C-5Ms and “ROYAL” or “RIDER” for C-17As, however they may use randomized callsigns so listen for odd sounding names (EAGLE, BUTTE, MEEK, etc.). Our mission crews use the “REACH” call-sign. Our aeroclub aircraft (Cessna-172 sized aircraft) use “IRONY.”

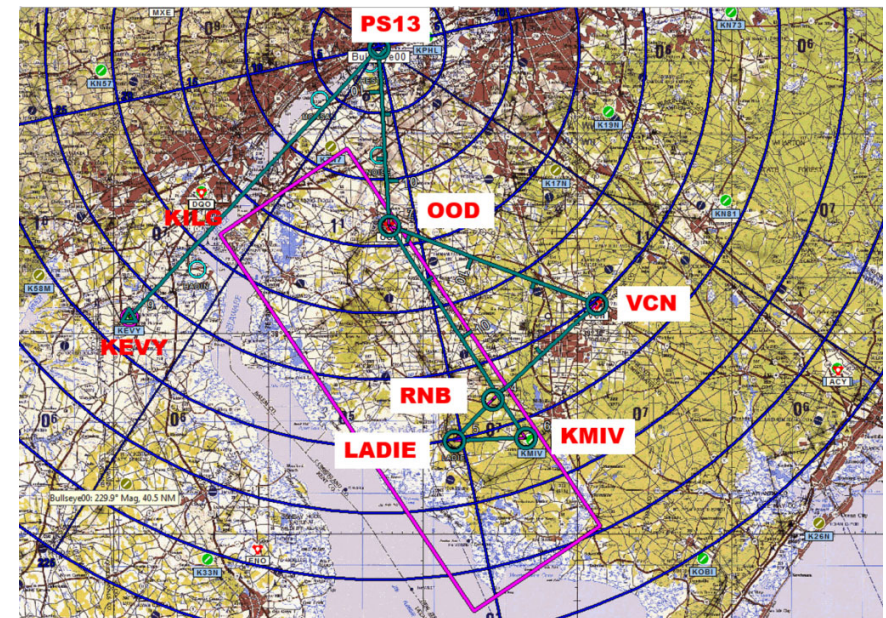


Typical Dover VFR traffic patterns.

VFR operations at and around Dover AFB are utilized during aircrew training maneuvers. Sometimes you will find us practicing high-speed, circling maneuvers at a variety of altitudes within 10 miles of the base. We also train quite a bit at night with our external lights extinguished. If you plan to transit Dover’s airspace while this kind of training is taking place, it is best to over-fly at or above 6,000 feet.

## CH-47/CV-22 TRAINING ROUTE & TEST FLIGHT AREA

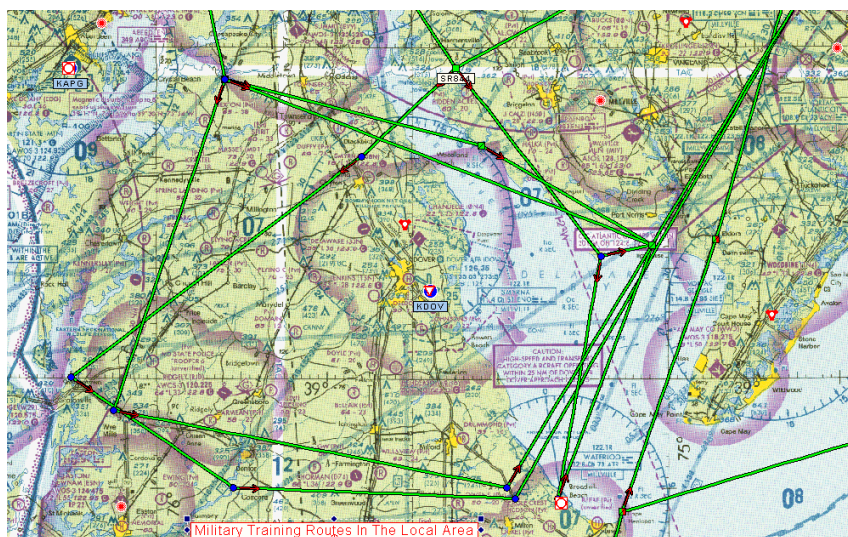
Also taking place in and around Dover’s Airspace, are functional check flights on new CH-47 helicopters and CV-22 tiltrotor aircraft. These aircraft typically fly between 1500-5000 feet MSL, at speeds of up to 250 knots, and can be identified by the call sign Army {Tail Number}. The daily route of flight for both aircraft is depicted below, beginning at the Boeing heliport (PS13) and terminating at Millville Municipal airport (KMIV). The magenta rectangle depicts the area where autorotation testing will be accomplished. It’s important to remain vigilant when around these aircraft, as they may be performing rapid descents, ascents, turns, or speed changes.





## MILITARY TRAINING ROUTES (MTRs)

National security largely depends on the ability of our military forces to safely deliver troops and equipment in a combat environment. One method we use while penetrating unfriendly airspace involves low-level flying. Being low-level proficient requires use of nationally-organized low-level Military Training Routes (MTRs). High-speed combined with low altitude make see-and-avoid much more difficult. Be vigilant when crossing a published MTR as any type of military aircraft could be on the route. Generally, the MTRs are established below 10,000 feet MSL for military operations at speeds in excess of 250 knots. Various aircraft use these routes from our large C-5M & C-17A to small F-16 fighter jets. There are 7 operational MTRs within 50 miles of Dover AFB: SR-800, 801, 805, 844, 845, and 846, and VR-1709.



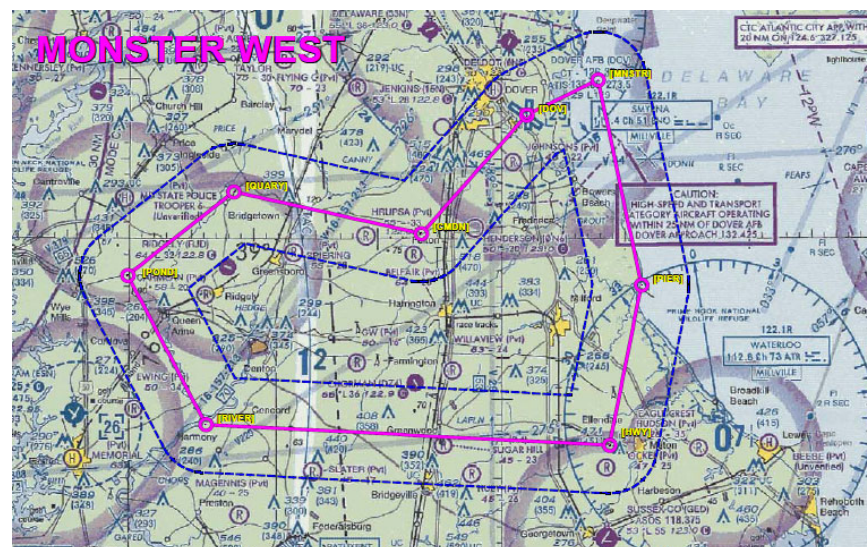
Military Training Routes (MTRs) in the vicinity of Dover AFB

Route widths can vary along the MTR and extend several miles on either side of the charted MTR centerline depicted on sectional charts. Military aircraft conducting low level training can be anywhere within a MTR's structure. Seldom will aircraft be on the centerline or at a constant altitude when VFR conditions exist.

When requesting MTR information, give the FSS your position, route of flight, and destination in order to permit the FSS specialist to identify the MTRs along your intended flight path. When you are operating along or near an MTR, the only means of separation between you and military aircraft is “**SEE AND AVOID.**”

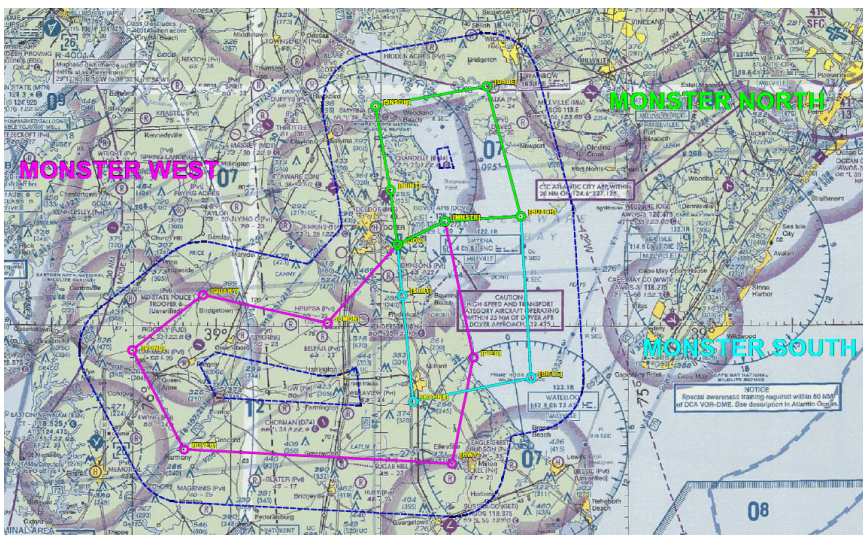
## MONSTER LOW LEVEL ROUTES (DOVER MTR)

In 2015, Dover AFB developed three Low Level Routes for local C-17A use: Monster North (MN), South (MS), and West (MW). They are ***not*** part of the MTR system. Monster West (MW) is the most frequently used. When entering MW, aircraft will typically fly a holding pattern for one or more turns for timing at 1000-1500 feet AGL at local point “BREW” (DOV/090/10). It is normally a right turn standard orbit holding North with 5-7 mile legs. Upon entry, the C-17A will typically fly these routes at 500-1000 feet AGL and 230–250 kts while remaining within 3 NM of the Monster Low Level centerline. They will avoid public and private airports by 3 NM laterally or 1,500 feet above. The low levels will be flown two to three times each week, both during the day and night.



Monster West Low Level With 3 NM to either side Corridor  
(6NM total)





### Monster Low Levels with 10 NM Corridor

(Note: Aircrew must remain within 3 NM of low-level centerline for MW; 2NM left and 0NM right for MN; and 2NM right, 0NM left for MS)

### ACTIONS TO REMEMBER

1. When planning a flight, especially below 1,500 feet AGL, carefully crosscheck available charts for the presence of MTRs and avoid them when possible. Only VR routes are depicted on sectional charts. SR, IR, and the local Monster routes are not shown!
2. MTR corridors are not depicted on sectional charts; only the centerline of the route is shown. The actual corridor along the route is normally 5 NM on either side of the centerline.
3. When flying in close proximity to MTRs, contact the nearest Flight Service Station (FSS) for current flight activity along the route.
4. If you must operate near or through an MTR, do so above 1,500 feet AGL, and maintain a vigilant watch for aircraft.
5. When crossing an MTR, do so perpendicular to the route.
6. If you see a military aircraft, assume they do not see you.
7. Wake turbulence from heavy, high-speed aircraft is severe!



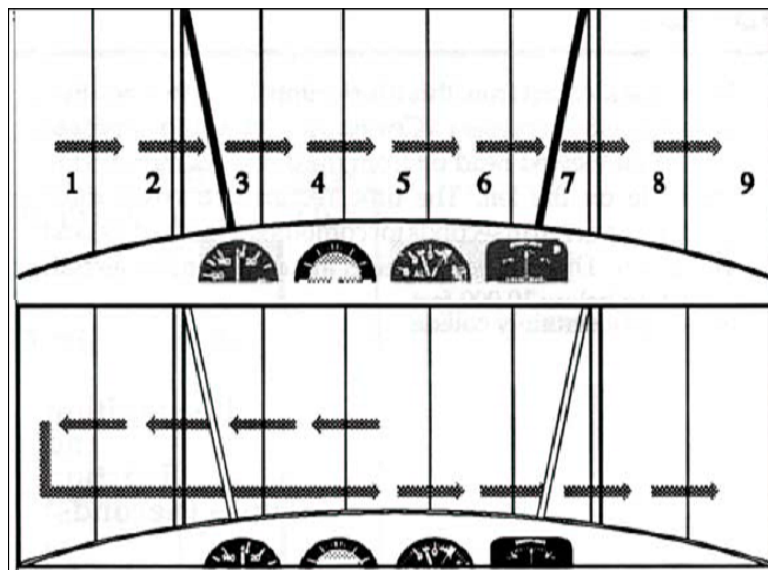
C-5 at less than ½ mile

## COMMON MISCONCEPTIONS

Do you think that controllers are in two-way communication with everyone on their scope? They're not! They are not in contact with many VFR A/C in their Airspace. This assumption can be fatal. Radar cannot protect you from unidentified aircraft. Most radar has “blind spots.” Just because you are under radar contact does not mean the controller can keep you away from 100% of air traffic. ATC can only control participating aircraft.

Many pilots believe any time they hear “Radar Contact” the controller has taken over all separation responsibilities. Pilots are never exempt from seeing and avoiding traffic conflicts. When under radar contact, the controller will share the responsibility with the pilot to resolve traffic conflicts. In the air, pilots are expected to pay attention to their surroundings. Anticipate what might happen by scanning the sky and listening to ATC frequencies. Know where traffic is and where you are. Most conflicts can be avoided by knowing where traffic is and where they are headed. Don't put all your trust in ATC when it comes to traffic avoidance! However, use radar services to the maximum extent possible. ATC is responsible to resolve traffic conflicts and can help you safely traverse controlled airspace. VFR pilots are highly encouraged to communicate with ATC and tell them their intentions.

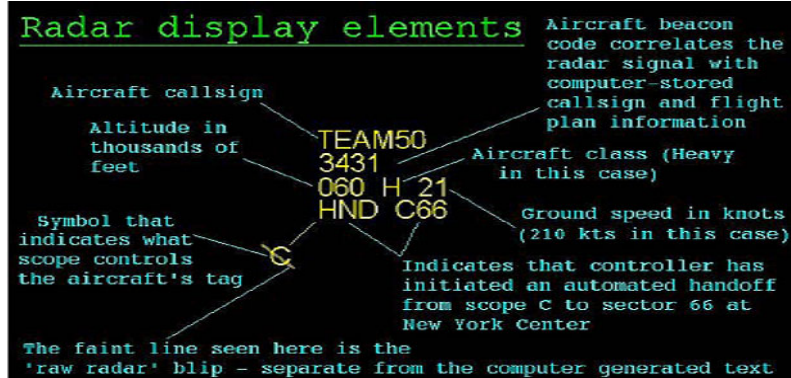




Common traffic scan patterns

## TRANSPONDERS

Private pilots can help ATC by installing a transponder in their aircraft. The difference between a non-transponder equipped aircraft and one with a transponder is substantial. Your operative altitude-encoding transponder can help Traffic Alert and Collision Avoidance System (TCAS) equipped C-5M and C-17A aircrews see and avoid you.



Depiction of aircraft information, provided by an aircraft's transponder, as displayed on the controller's screen

## TCAS

As a GA pilot, you're probably wondering "what does TCAS have to do with me?" First of all, knowing the basics of TCAS will assist you when flying in congested areas shared by the larger aircraft and you'll realize *how important it is to have your transponder on*. Secondly, collision avoidance technology is finding its way to the GA market and is becoming more capable and affordable.



Example of a TCAS display

Airliners and larger commuter aircraft with passenger seat capacity greater than 30 are now equipped with TCAS. In order for TCAS to provide alerts and advisories, the conflicting aircraft must have an operational transponder. A Resolution Advisory (RA), which is the active vertical guidance provided by TCAS, requires the conflicting aircraft to have Mode C altitude reporting capability. **TCAS is blind to aircraft without a transponder or with their transponder turned off.**



## MID-AIR COLLISION STATISTICS

Almost 50 percent of mid-air collisions result in at least one death. Naturally, mid-air collision avoidance (MACA) is an important aviation safety topic. With the sky becoming more and more congested, the threat of a mid-air collision is increasing. According to the NTSB, the most probable cause of mid-air collision is the “pilot in command failed to see and avoid other aircraft.” Aircraft speeds today challenge our ability to “see and avoid.” Here are a few facts about mid-air collision:

1. Mid-air collisions generally occur during weekend daylight hours.
  - ➔ 56% of the accidents occurred in the afternoon.
  - ➔ 32% of the accidents occurred in the morning.
  - ➔ 2% of the accidents occurred at night, dusk, or dawn.
2. Most mid-air collisions occur under good visibility.
3. The majority of the aircraft involved in collisions are not on any type of flight plan.
4. Nearly all accidents occur at or near uncontrolled airports and at altitudes below 1000 ft.
5. Flight fatigue, fatigue resulting directly from flight related operations, is not a major factor in most mid-air collisions.
  - ➔ The average flight time prior to the collision is 45 minutes. This time varies from takeoff to over seven hours.
  - ➔ 60% of the pilots on the mishap flight had been airborne thirty minutes or less.
  - ➔ Only 6% had been flying longer than two hours.
6. Pilots of all experience levels are involved in mid-air collisions, from the first solo ride to 20,000 hour veterans.

## COLLISION AVOIDANCE TIPS

1. Clear constantly for other aircraft, both visually and over the radios.
2. Know where high-density traffic areas are.
3. Always monitor the appropriate frequencies.
4. Obtain an IFR clearance or participate in radar flight following whenever possible and continue to practice “see and avoid” at all times.
5. Under IFR control, do not count on ATC to keep you away from other aircraft. There may be VFR aircraft operating in your environment that ATC is unaware of.
6. Use landing lights at lower altitudes, especially when near airports.
7. Announce your intentions on UNICOM and use standard traffic pattern procedures at uncontrolled airfields.... Be predictable!
8. If your aircraft is equipped with a transponder, turn it on and adjust it to reply on both Mode 3/A and C.
9. Use the appropriate hemispherical altitudes and don’t let your altitude “wander.”
10. Fly as high as possible.
11. Keep your windscreen clean. A bug on the windscreen can obstruct other airborne aircraft coming your way.
12. Don’t get complacent during instruction! Statistically, instructors are on board during 37 percent of flying accidents.
13. When flying at night, avoid white light in the cockpit. White light disrupts your night vision, even when used momentarily.
14. Beware of wake turbulence.
15. Understand the limitations of your eyes and use proper visual scanning techniques. If an aircraft appears to have no relative motion but is increasing in size, you are on a collision course.
16. Practice appropriate clearing procedures before and during all climbs, descents, and turns.
17. Be aware of the type airspace in which you intend to operate and comply with applicable rules.
18. Avoid complacency. SEE AND BE SEEN!



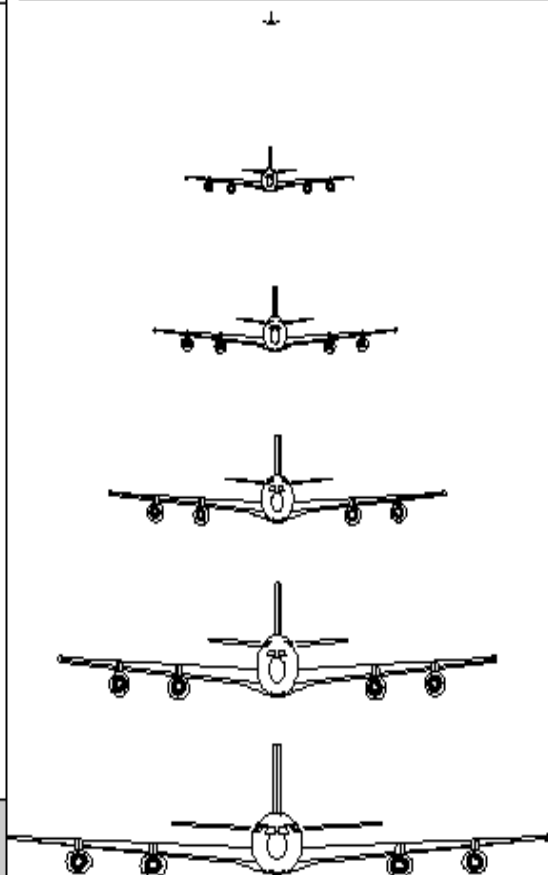
# AIRCRAFT CLOSURE RATE CHART

Based on combined speeds of two aircraft

Distance Seconds

**Move back six feet from this illustration.** From that position the pictures of the KC-135 approximate your perception of the aircraft at the corresponding distances on the chart. Taking into account the recognition and reaction times shown in the table to the left, the shaded blocks in the chart indicate distances where aircraft on collision courses would surely collide.

	At 600 MPH	At 210 MPH
10 Miles	60	170
5 Miles	30	85
3 Miles	18	56
2 Miles	12	38
1 Mile	6	18
.5 Mile	3	9



The areas in the gray box are the danger areas. This is based on recognition and reaction times.

# 10 SECONDS TO IMPACT

This is the approximate size of each aircraft as they would look to you from a head on collision course.

(APPROXIMATE VIEWS SHOWN BELOW)

## ONE MILE APART

Intruder traffic speed is 250 KIAS, your speed is 110 KIAS

Closure rate is 360 knots: 6 NM per minute

600 feet (two football fields) per second

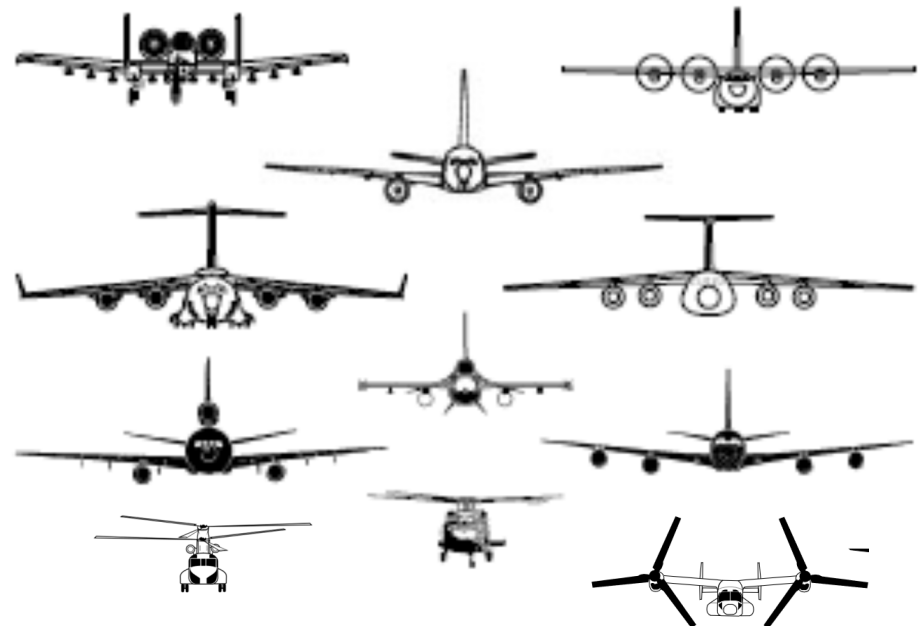
## REACTION TIMES

6 seconds to see, recognize, and analyze...

4 seconds to decide and start evasive maneuver

2 seconds to gain enough space to clear...

(10 seconds to impact: 12 seconds needed to avoid impact)





## DETECTING TRAFFIC

The detection of airborne object depends on five conditions:

1. Image size – size of the object relative to visual field-of-view
2. Contrast – difference between object and background brightness, color, and shape
3. Adaptation – degree to which your eyes adjust to surrounding illumination
4. Motion – velocity of the object relative to you
5. Exposure – length of time object is in view

### LARGE AIRCRAFT ILLUSIONS

Since the C-5M and the C-17A are so large, they may appear to be hanging in the sky and traveling quite slowly. Don't be deceived! A typical final approach speed with flaps down is around 125 knots!

Another illusion involves the flight path. When flying at slower airspeeds, the high deck angle of the airplanes give the illusion the aircraft is climbing. We've had airplanes at higher altitudes descend toward us thinking the C-5M or C-17A was climbing toward them! If you doubt the altitude of the traffic, ask the controller...or ask the C-5M or C-17A itself.



## NEAR MID-AIR COLLISION REPORTING

**Definition:** A near mid-air collision (NMAC) as defined by the AIM (7-6-3) is “an incident associated with the operation of an aircraft in which a possibility of collision occurs as a result of proximity of less than 500 feet to another aircraft, or a report is received from a pilot or a flight crew member stating that a collision hazard existed between two or more aircraft.”

Although the AIM mentions a definitive 500-foot proximity in this definition, it goes on to allow the pilot or flight crew member to make a determination as to if a collision hazard existed regardless of how close the aircraft came to one another. Therefore, use your judgment and make an honest assessment. If you believe a collision hazard existed, report it. It's your responsibility!

**Reporting a NMAC:** First of all, you must inform ATC by using the following verbiage. ***“I wish to report a near mid-air collision.”*** This is in accordance with the AIM 7-6-3. A “Man that was close!” will not necessarily convey your intent. Properly notifying ATC will ensure the necessary data is saved. NMACs are reported on **FAA Form 8020-21**, “Preliminary Near Mid-air Collision Report,” and should contain the following information:

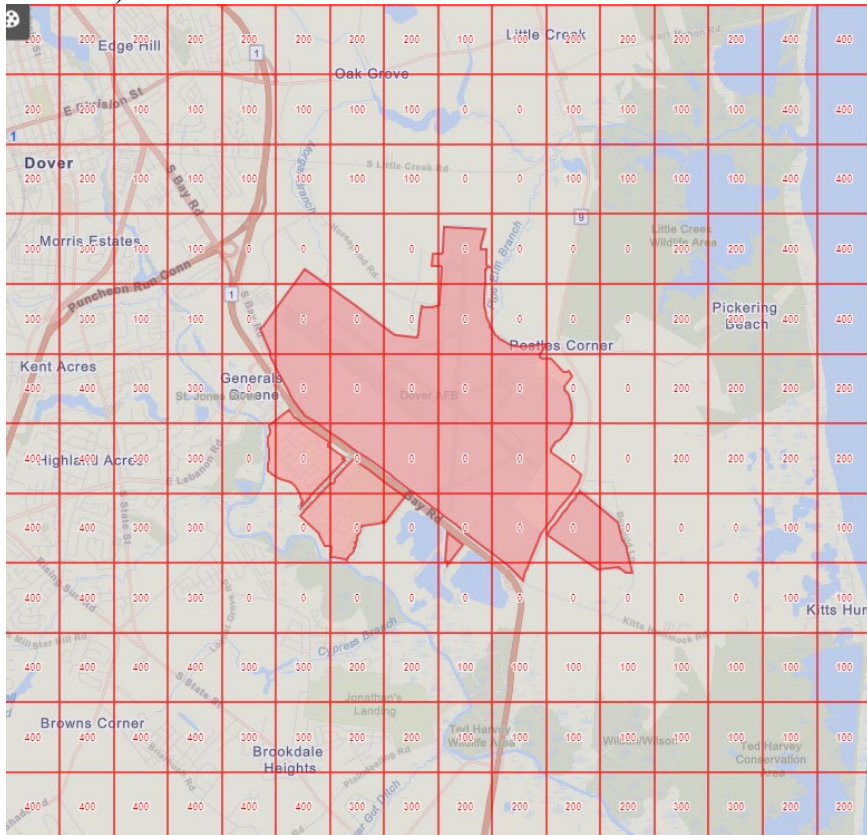
- Date, time, and location of the NMAC
- Fix or facility nearest the NMAC
- The NMAC location in respect to the fix or facility
- Aircraft information, such as make, model, and registration number
- Type of flight rules during the NMAC
- The aircraft altitude during the NMAC
- A brief description of the NMAC, along with comments
- Aircraft altitude when the deviation was detected
- A brief description of the deviation, with appropriate comments

Your participation in the reporting process is highly encouraged and essential for improvements in the air traffic system and mishap prevention.

## UAS/DRONE Operations

UAS/drone operations are just as dangerous to manned aircraft as birdstrikes. In fact they are of a greater hazard as birds will at least attempt to get out of the way and are made of flesh instead of plastic and metal. Additionally, FAA rules and restrictions on drone operations is rapidly changing and it is incumbent on the operator to know and be aware of those rules.

Unauthorized UAS/drone activity on and around Dover AFB is **prohibited** and may result in legal penalties. Use this web address for a map of UAS ceilings and other restricted airspace around the country. <https://udds-faa.opendata.arcgis.com/>  
Below is an excerpt from that website around Dover AFB. The red numbers are the authorized ceiling for UAS operations in feet (Ex: 0=not authorized, 100=100feet is maximum altitude of a UAS in that area)



## MILITARY AIRCRAFT IN DOVER AREA

### Lockheed C-5M Super Galaxy

The C-5M is a strategic, high speed, four engine jet transport aircraft. With a takeoff weight of 840,000 lbs, the C-5M is similar in size to the Boeing 747. The C-5M is categorized as a heavy aircraft. With its large "T" tail and high wing configuration, its shape is similar to that of the C-17A.





## Boeing C-17A Globemaster III

The C-17A is a strategic & tactical, high speed, four engine jet transport aircraft. With a takeoff weight of 585,000 lbs, the C-17A is slightly smaller in size than the C-5M. The C-17A is categorized as a heavy aircraft. With its large “T” tail and high wing configuration, its shape is similar to that of the C-5M.



## Boeing CH-47F Chinook

The Chinook is a multi-mission, heavy-lift transport helicopter. Its primary mission is to move troops, artillery, ammunition, fuel, water, barrier materials, supplies and equipment on the battlefield. Its secondary missions include medical evacuation, disaster relief, search and rescue, aircraft recovery, firefighting, parachute drops, heavy construction and civil development.



**Variances of the CH-47F include the MH-47G**



## Boeing MH-139A Grey Wolf

Boeing's MH-139A Grey Wolf is a multi-mission helicopter designed to protect intercontinental ballistic missiles and transport U.S. government officials and security forces. Produced in the United States, the MH-139A provides an off-the-shelf, readily available solution combining performance, operational flexibility and safety.



## Boeing CV-22 Osprey

The CV-22 Osprey is a tiltrotor aircraft that combines the vertical takeoff, hover and vertical landing qualities of a helicopter with the long-range, fuel efficiency and speed characteristics of a turboprop aircraft. Its mission is to conduct long-range infiltration, exfiltration and resupply missions for special operations forces.







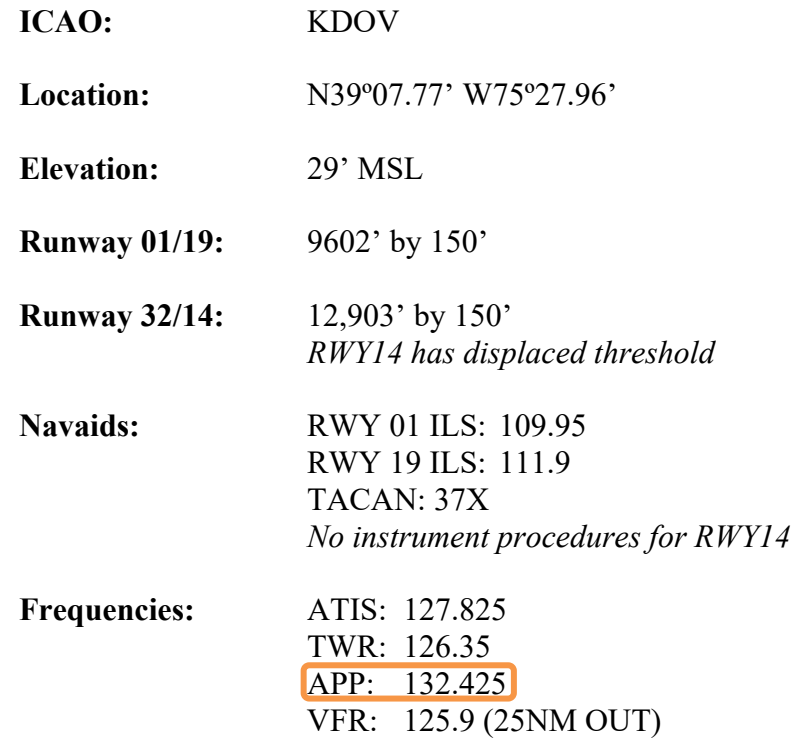
# Boeing C-32

The C-32 is a variant of the Boeing 757 providing executive transport and communication to senior leaders (Secretaries, Cabinet, Congress) and will occasionally serve as Air Force One with which it shares a paint scheme. Often comes to Dover for pattern work.



<b>VC-25A/ Boeing 747</b>		<b>Wingspan:</b> 195 ft <b>Length:</b> 231 ft <b>Height:</b> 63 ft <b>Color:</b> White/Blue various	<b>Normal Rate of Climb:</b> 2,000 to 4,000 FPM <b>Normal App Speed:</b> 150 Knots
<b>C-21</b>		<b>Wingspan:</b> 40 ft <b>Length:</b> 49 ft <b>Height:</b> 17 ft <b>Color:</b> White	<b>Normal Rate of Climb:</b> 2,000 to 4,000 FPM <b>Normal App Speed:</b> 140 Knots
<b>C-130</b>		<b>Wingspan:</b> 132 ft <b>Length:</b> 97 ft <b>Height:</b> 38 ft <b>Color:</b> Grey or Green	<b>Normal Rate of Climb:</b> 1,500 FPM <b>Normal App Speed:</b> 140 Knots
<b>C-17</b>		<b>Wingspan:</b> 169 ft <b>Length:</b> 174 ft <b>Height:</b> 55 ft <b>Color:</b> Dark grey	<b>Normal Rate of Climb:</b> 2,000 to 4,000 FPM <b>Normal App Speed:</b> 135 Knots
<b>C-5M</b>		<b>Wingspan:</b> 222 ft <b>Length:</b> 247 ft <b>Height:</b> 65 ft <b>Color:</b> Dark grey	<b>Normal Rate of Climb:</b> 1,500 to 2,000 <b>Normal App Speed:</b> 130 Knots
<b>CH-47</b>		<b>Rotor Span:</b> 51X98 Ft <b>Length:</b> 51 ft <b>Height:</b> 18 ft <b>Color:</b> Tan	<b>Normal Rate of Climb:</b> 500 to 1,500 <b>Normal App Speed:</b> 90 Knots
<b>CV-22</b>		<b>Wingspan w/ rotors:</b> 85 Ft <b>Length:</b> 57 ft <b>Height:</b> 22 ft <b>Color:</b> Grey	<b>Normal Rate of Climb:</b> 2,300 to 4,000 <b>Normal App Speed:</b> 120 Knots
<b>MH-139</b>		<b>Wingspan w/ rotors:</b> 45 Ft <b>Length:</b> 55 ft <b>Height:</b> 16 ft <b>Color:</b> Grey	<b>Normal Rate of Climb:</b> 1,500 to 2,500 <b>Normal App Speed:</b> 135 Knots

## DAFB AIRFIELD INFORMATION



**Not to be used for navigation.**