BY ORDER OF THE COMMANDER
171 ARW Commander & 911 AW Commander

171 ARW / 911 AW PAMPHLET 91-102
17 DECEMBER 2024

Safety

MID-AIR COLLISION AVOIDANCE (MACA) PAMPHLET

NOTICE: This publication is available digitally on the 171 ARW SharePoint website and 911 AW SharePoint website.

OPRs:
171 ARW/SE (Capt Matthew R. Limina)
911 AW/SE (Lt Col Scott Cook)

Certified By:
171 ARW/CC (Col Raymond L. Hyland)
911 AW/CC (Col Douglas A. Stouffer)

Supersedes: 171 ARW / 911 AW Pamphlet 91-102, 1 MARCH 2021

Pages: 21

Distribution: F

Aviation Enthusiasts: Welcome to the Pittsburgh International Airport. We applaud and encourage your interest in making the skies over the Pittsburgh International Airport a safer place to fly. This joint Mid-Air Collision Avoidance (MACA) pamphlet will provide you with valuable information to help make your journey through this high traffic airspace safe and mishap free.

SUMMARY OF REVISIONS
This document has significantly changed and must be reviewed in its entirety. This revision incorporates operations at both the 171 ARW and 911 AW.

1. MID-AIR COLLISION AVOIDANCE (MACA) PROGRAM OVERVIEW

1.1. BACKGROUND: The 171stAir Refueling Wing (Air National Guard) and the 911th Airlift Wing (Air Force Reserves) are located at the Pittsburgh International Airport. The 171 ARW is host to the KC-135R/T Stratotanker, while the 911 AW is home of C-17A Globemaster aircraft. Included in this pamphlet is information to familiarize you with our aircraft, their appearance, and the routes and altitudes we fly.

1.2. GOALS: In simplest terms, the goal of the MACA program is "to make the skies in the vicinity of Pittsburgh International Airport (KPIT) the safest flying environment possible." Prepared jointly by Air Force Flight Safety Offices and local air traffic control (ATC), this pamphlet contains valuable information to help manage your flying and increase your situational awareness (SA) around Pittsburgh International Airport's airspace.

KPIT has extensive use of both privately owned aircraft and commercial aviation traffic. As our airspace becomes more congested, the possibility of a mid-air collision increases. Therefore, operations in our local area requires extra vigilance and increased awareness to effectively manage the risk associated with air traffic density.

The MACA program provides vital information to both military and civilian aviators to promote an environment of shared expectations and understanding. Communication with air traffic control agencies, aggressive clearing by aviators, use and monitoring of Traffic Collision Avoidance Systems (TCAS), and general knowledge of the airspace in and around the vicinity of KPIT will help us safely operate together. Within these pages, you will find helpful information concerning our airspace, flight patterns, operating procedures, restricted areas and military aircraft familiarization.

1.3. CONTACT: After reviewing this pamphlet, if you have any questions or concerns, please do not hesitate to contact the Flight Safety Office(s) directly.

171 Air Refueling Wing	**911 Airlift Wing**	**KPIT FAA Tower**
(412) 776-7337 / 7377	(412) 474-8513	(412) 472-5592
171.ARW.Safety@us.af.mil	911AW.SE@us.af.mil	

2. PROFILE OF MID-AIR COLLISIONS

2.1. HISTORY: Studies of the mid-air collision problem conclude that there are definite warning patterns. It may be surprising to some that nearly all mid-air collisions occur during daylight hours and in visual meteorological conditions (VMC). Perhaps not so surprising is that the majority happen within 5 miles of an airport, in the areas of greatest traffic concentrations, and usually on warm weekend afternoons when the airspace is more congested with leisure flyers.

The general aviation pilot is familiar with avoiding other civilian aircraft however they usually are not familiar with the much faster closure rates of military aircraft and often does not react soon enough to avoid a potentially dangerous situation. No pilot is immune: 38% of pilots involved had less than 1000 hours of flight time, however experience is not always protective –25% had more than 5000 hours.

Statistics on in-flight collisions show that 82% were at overtaking convergence angles: 35% were from 0 to 10 degrees – almost straight from behind! Only 5% were from a head-on angle. We must take an active role in reducing the chances of a mid-air collision; no pilot is invulnerable. **Stay Alert and Stay Alive!**

2.2. STATISTICS OF NEAR MID-AIR COLLISIONS (NMAC):

75% of NMAC involve General Aviation aircraft

Nearly 70% occur near airports and 85% occur below 3000' AGL

Over 50% occur at airfields with towers

Over 50% involve pilots not using "See and Avoid" techniques

90% of aircraft involved are small light airplanes

2.3. STATISTICS OF ACTUAL MID-AIR COLLISIONS (MAC):

Less than 10% occur when both aircraft are in radar contact

Nearly 100% take place during day VMC

67% of mid-air collision reports say visibility was greater than 10 miles.

40% occur during cruise flight

20% involve an aircraft where flight instruction is taking place

95% of aircraft involved are small light airplanes

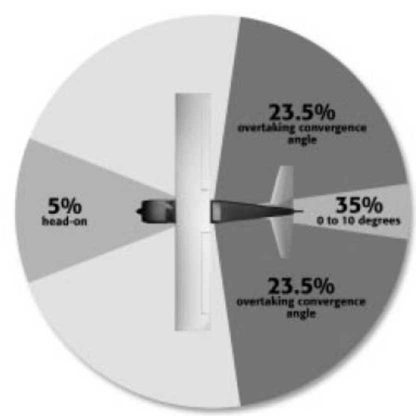


Figure 2.1

Credit: AOPA Air Safety Foundation *Safety Advisor*, "Collision Avoidance: Strategies and Tactics"

<u>Data Sources:</u>
FAA Aviation Safety Program publication P-8740-51
Kunzi, F. and Hansman, R. (2011) *Mid-Air Collision Risk and Areas of High Benefit for Traffic Alerting*
Taneja, N. and Wiegmann, D. (2001) *Analysis of Mid-Air Collisions in Civil Aviation*

2.4. 171ARW / 911AW NEAR MID-AIR COLLISIONS (NMAC) POTENTIAL: With the exception of VFR low levels, the majority of 171ARW / 911AW flying occurs under Instrument Flying Rules and Air Traffic Control Radar Services. With that in mind NMACs occur at a rate less than 1 per year for the 171ARW and 911AW collectively. While the overall threat of NMACs is low, it can be further reduced utilizing ATC radar services and the techniques discussed in section 7 of this publication.

3. FLYING IN THE PITTSBURGH (KPIT) TERMINAL AREA

3.1. LOCATION AND SERVICES: The Allegheny County Airport Authority (ACAA) operates and manages Pittsburgh International Airport. The airport is in Western Pennsylvania approximately 15 miles northwest of Pittsburgh, PA. Pittsburgh International encompasses 10,000 acres and provides 24/7 approach and departure service to any of four main runways: 28L/10R, 28C/10C, 28R/10L and 14/32. KPIT is classified as FAA Class B airspace.

3.2. DEPARTURES AND ARRIVALS: The high number of flight operations makes aircraft departures and arrivals demanding, even to experienced pilots. Traffic avoidance, radio discipline and precision flying are a must. In addition, the airport is experiencing growth of airline operations, resulting in steadily increasing traffic flow.

A. Departures: On IFR departures, aircraft can be expected to climb quickly to 4,000' MSL (propeller), 5000' MSL (jet) or above. Instrument arrivals may be requested to maintain higher forward airspeeds or quickly slow to approach speeds based on traffic pattern congestion.

I. If the airport is using a westbound flow, aircraft departing from 28L/C/R will initially fly a westerly heading before being vectored north or south. Runway 32 is not used for departures due to noise and obstructions.

II. East flow departures from all runways are normally assigned the appropriate runway heading for noise abatement until advised by tower.

III. If you are departing from the 171 ARW ramp, expect to depart on 28L from intersection P (Takeoff Run Available = 10,500' 28L@P) or expect runway 10C. If full length is required, coordinate with ground control on taxi out.

IV. Aircraft departing from the 911 AW ramp may expect departure from 28C/10C, 28R, or runway 14.

B. Arrivals:

I. During the normal west flow operations, the airport will utilize simultaneous ILS/visual approaches to Runways 28L/R and 32. Runway 28C is normally reserved for departures but may be coordinated for landing from a sidestep approach.

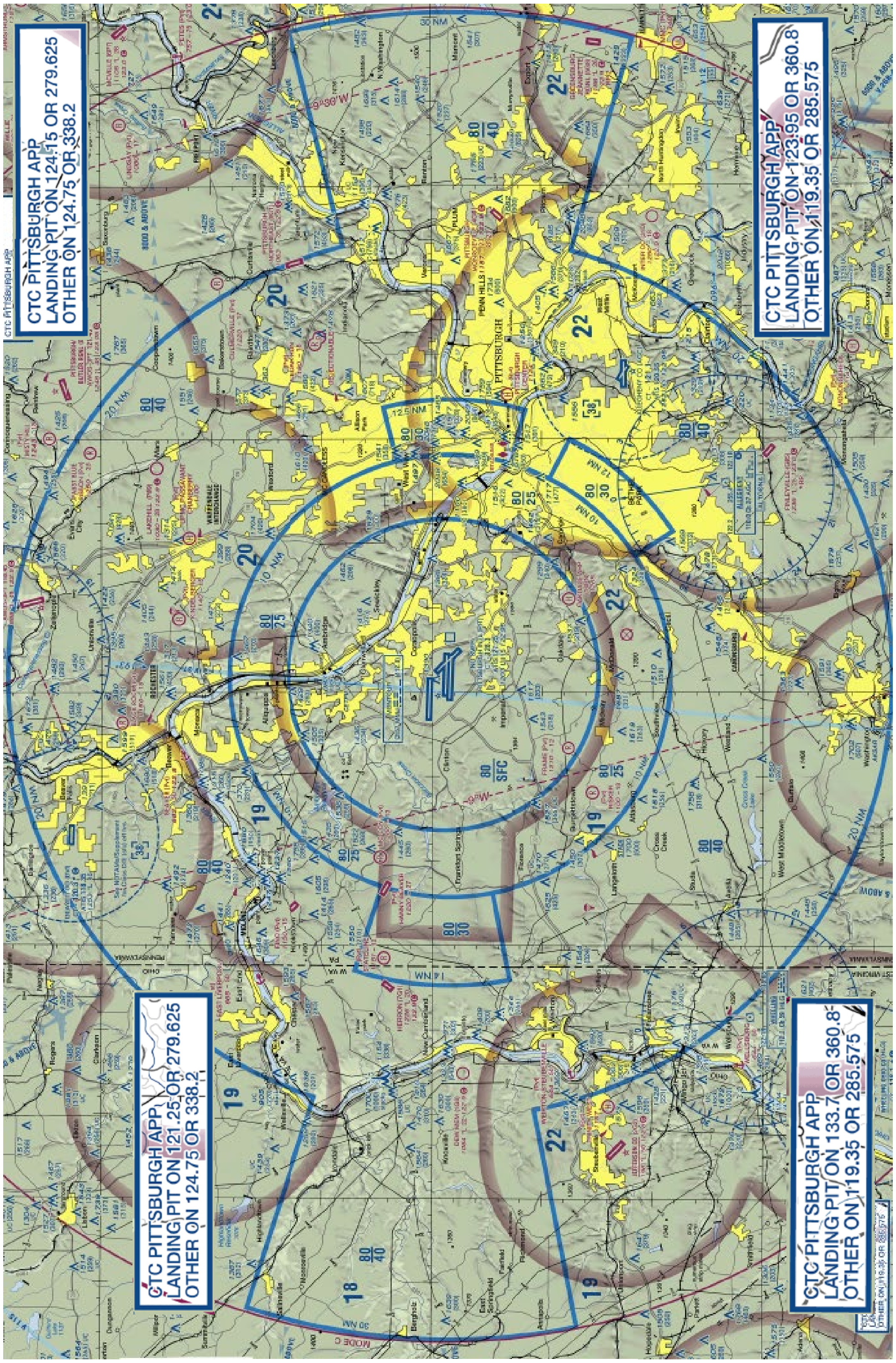
II. During east flow operations, ATC will utilize simultaneous approaches to 10R/L. The assigned runway is dependent on the aircraft's arrival fix. Approaches to 10C are rarely conducted and runway 14 is not used for turbojet arrivals due to noise and obstructions.

III. If the 171 ARW ramp is your destination, expect to be vectored to runway 10R/28L or 32, regardless of your arrival fix. This precludes a long taxi from runways 10L/28R to the ramp. Vigilance must be used during the arrival, as you may be vectored through the final approach of other aircraft utilizing other runways.

3.3. PEAK TRAFFIC PERIODS: Peak traffic at the Pittsburgh International Airport occurs at random times throughout the day and night, where controllers experience higher numbers of departures and arrivals. During these time periods, aircraft spacing is minimized and radio traffic is very high. Since these periods are variable based on current airport traffic flow, vigilance must be always used during ground and flight operations.

3.4. KPIT RADIO FREQUENCIES:
ATIS: 127.25 (Arrival), 135.9 (Departure)
Ground: 121.9/348.6 (South), 127.8 /348.6 (North)
Departure: 119.35
Tower: 128.3 / 291.7

Figure 3.1. PITTSBURGH CLASS B AIRSPACE



NOT TO BE USED FOR NAVIGATION

4. 171 AIR REFUELING WING / KC-135 OPERATIONS

4.1. FLYING MISSION: The federal mission of the Pennsylvania Air National Guard is to staff, equip and maintain combat flying/support units to augment the U.S. Air Force. Many of our flight operations are in direct support of our federal mission. The KC-135T Stratotanker's principal mission is air refueling. This aircraft greatly enhances the U.S. Air Force's capability to accomplish its mission of Global Engagement. It also provides aerial refueling support to U.S. Navy, Marine Corps and allied aircraft.

4.2. FLIGHT OPERATIONS: Our dual-role, refuel and airlift of cargo/passengers, KC-135T's primary mission is to refuel aircraft in-flight, allowing the receiver aircraft to fly non-stop. Our secondary mission is transporting cargo and passengers to worldwide locations. In performing this secondary mission, our tankers are continuously called upon to airlift cargo and passengers globally. It is not unusual for several of our aircraft to be deployed simultaneously to various locations around the world performing refueling and airlift missions.

In addition to our primary flying mission, the 171 ARW personnel are regularly called upon to assist federal and state agencies during natural disasters such as floods, heavy snowstorms and tornadoes. The 171 ARW is also called upon to assist during civilian disasters.

4.3. 171 ARW VFR TRAINING AT KPIT:

A. VFR Traffic Pattern: KC-135 aircraft conduct VFR traffic pattern training at KPIT to all runways at the airport as assigned by ATC. The traffic pattern altitude for turbojet aircraft is 2,700 feet MSL. KC-135 aircraft will normally fly the VFR pattern at 2700 feet MSL, 180 knots and remain within 3 nm of the assigned runway.

B. VFR Overhead Pattern: KC-135 aircraft conduct VFR overhead pattern training at KPIT to all runways at the airport as assigned by ATC. ATC will normally vector aircraft to a 3-5 nm initial leg where the aircraft will proceed inbound along the extended runway centerline at 2,700 feet MSL and 250 knots. The aircraft will "break" left or right at the midpoint of the runway (or as assigned by ATC), decelerate and configure for landing. This pattern may also be conducted in a formation where subsequent aircraft will be stacked up 500 feet and one mile in trail of the preceding aircraft.

4.4. 171 ARW OPERATIONS AT REGIONAL AIRPORTS: Additionally, Pittsburgh-based KC-135 crews may accomplish IFR and VFR traffic pattern training at the following airports in the region:

A. Youngstown-Warren Regional (KYNG), Youngstown, OH

B. Rickenbacker International Airport (KLCK), Columbus, OH

C. Harrisburg International Airport (KMDT), Middletown, PA

5. 911 AIRLIFT WING / C-17 OPERATIONS

5.1. FLYING MISSION AND OPERATIONS: The 911th Airlift Wing operates the C-17 Globemaster aircraft in support of strategic airlift training and both peacetime and combat operations. The majority of our local training is to enhance mission capability in single-ship low-level environment for cargo delivery via tactical arrivals to a landing zone. We practice takeoff, landing and instrument approaches and procedures, low level route training, short field (“assault”) landings and takeoffs and aerial refueling. The majority of our tactical night flying is performed using Night Vision Goggles (NVGs) where most aircraft lights are turned off.

5.2. 911 AW TACTICAL ROUTES: The training area for Pittsburgh-based C-17’s spans from western Ohio to eastern New Jersey and from northern New York to southern South Carolina. On a day-to-day basis, most of our VFR tactical flying is done east of Pittsburgh near and beyond Harrisburg, PA and the Harrisburg International Airport (KMDT). To the south, we typically fly VFR training routes from central Virginia down to Charleston AFB, SC (KCHS). In addition, we have several IFR routes flown at 1000’ AGL to upwards of 8000’ MSL which extend east and south towards the previously mentioned geographic areas.

A. VFR Tactical Flying: Flights along our VFR routes are routinely flown at 300-500’ AGL, both day and night. When encountering military aircraft at these altitudes, it is important to remember that C-17s frequently travel at speeds in excess of 300 knots in their low level training corridors. Additionally, during night operations, C-17 crews are usually using NVGs, which requires that we only use dim positional lighting, which is only visible in very close proximity to an aircraft.

B. IFR Tactical Flying: Since the C-17 is an all-weather capable platform, we routinely fly under instrument flight rules using on-board radar equipment to navigate a route and simulated landing zone. Flights along our IFR routes are flown at published military training route altitudes, both day and night, as per DOD Flight Information Publication AP/1B.

C. Simulated Landing Zone Considerations: During some of our low level training routes, C-17 crews will simulate arriving at a tactical landing zone at a specified target time. Upon reaching the Initial Point leading into a geographical point that simulates this landing zone, C-17 aircrews are very busy – we are preparing for a tactical arrival, slowing the aircraft to approach airspeed (approximately 130 knots) at the enroute altitude, configuring with gear and flaps, accomplishing internal checklists, and visually acquiring the simulated landing zone. Be aware that you are probably much more maneuverable than we are during these times!

5.3. 911 AW VFR TRAFFIC PATTERNS AT KPIT:

A. VFR Traffic Pattern: C-17 aircraft conduct VFR traffic pattern training at KPIT to all runways at the airport as assigned by ATC. C-17 aircraft will normally fly the VFR pattern at 2,700 feet MSL, 160 knots and remain within 3 nm of the assigned runway.

B. VFR Overhead Pattern: C-17 aircraft conduct VFR overhead pattern training at KPIT to all runways at the airport as assigned by ATC. ATC will normally vector aircraft to a 3-5 nm initial leg where the aircraft will proceed inbound along the extended runway centerline at

3,200 feet MSL and 250 knots. The aircraft will "break" left or right at the midpoint of the runway (or as assigned by ATC), decelerate and configure for landing.

5.4. 911 AW OPERATIONS AT REGIONAL AIRPORTS: Additionally, Pittsburgh-based C-17 crews may accomplish IFR and VFR traffic pattern training at the following airports in the region:

A. Youngstown-Warren Regional (KYNG), Youngstown, OH

B. Wright-Patterson AFB (KFFO), Dayton, OH

C. Dover Air Force Base (KDOV), Dover DE

D. Eastern West Virginia Regional Shepherd Field (KMRB), Martinsburg, WV

E. Lakehurst Maxfield Field (KNEL), Lakehurst, NJ

F. North Air Force Auxiliary Air Field (KXNO), Charleston, SC

G. Wheeler-Sack Army Airfield (KGTB), Ft Drum, NY

6. AIRCRAFT IDENTIFICATION

6.1. KC-135: The KC-135 is a long range, high speed, four engine jet aircraft capable of takeoff weights more than 300,000 lbs. With a fuel off-load capability of over 21,000 gallons; the KC-135's primary mission is to extend the range of USAF, USN, and allied military aircraft. The KC-135 is a military version of the Boeing 707 jet transport and is characterized by its swept wings and its air-refueling boom located below the horizontal stabilizer. KC-135 missions are conducted in the Class B airspace at altitudes and airspeeds up to 14,000 feet MSL and 250 KIAS.

Wingspan: 131 ft	**Length:** 129 ft	**Color:** Gray
Max Takeoff Weight: 320,000 lbs	**Max Cruise Speed:** 585 MPH at 30,000 ft MSL	
Approach Speed: 130-180 KIAS	**VHF Radio:** Yes	**TCAS:** Yes

FIGURE 6.1. KC-135 Stratotanker

6.2. C-17: The C-17 is a long-range, air-refuelable, heavy logistic transport aircraft powered by four Pratt & Whitney jet engines. Its design characteristics give it the capability to operate into and out of short runways and austere airfields carrying large payloads. The aircraft is designed to airlift palletized cargo, rolling stock, troops, passengers, and aeromedical evacuation patients. Recognized by its T-tail vertical stabilizer and upswept winglets, 911AW C-17's operate in Class B airspace at altitudes up to 10,000 feet and 250 KCAS.

Wingspan: 169 ft, 10 in	**Length:** 174 ft	**Color:** Gray
Max Takeoff Weight: 585,000 lbs	**Max Range Cruise Speed:** 0.74	
Approach Speed: 110-150 KIAS	**VHF Radio:** Yes	**TCAS:** Yes

FIGURE 6.2. C-17 Globemaster

6.3. OTHER FREQUENT TRANSIENT AIRCRAFT: Due to its strategic location and high-volume capability, Pittsburgh International Airport and its associated ANG/USAFR units are host to several military transient aircraft operations to support CONUS missions. Some of the aircraft you may see over the skies of Pittsburgh include:

C-130 Hercules
Radar Pattern Speed:
170 KIAS
Final Approach Speed:
110 - 130 KIAS

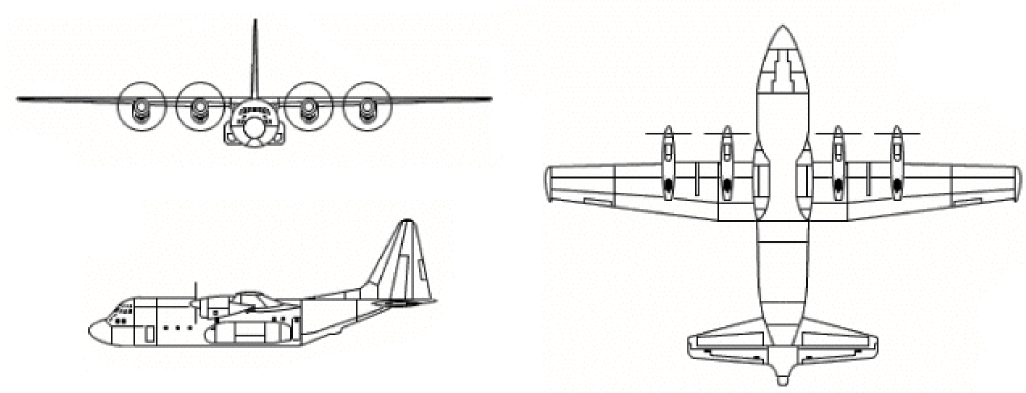


FIGURE 6.3. C-130 Hercules

C-5 Galaxy
Radar Pattern Speed:
210 KIAS
Final Approach Speed:
110 - 140 KIAS

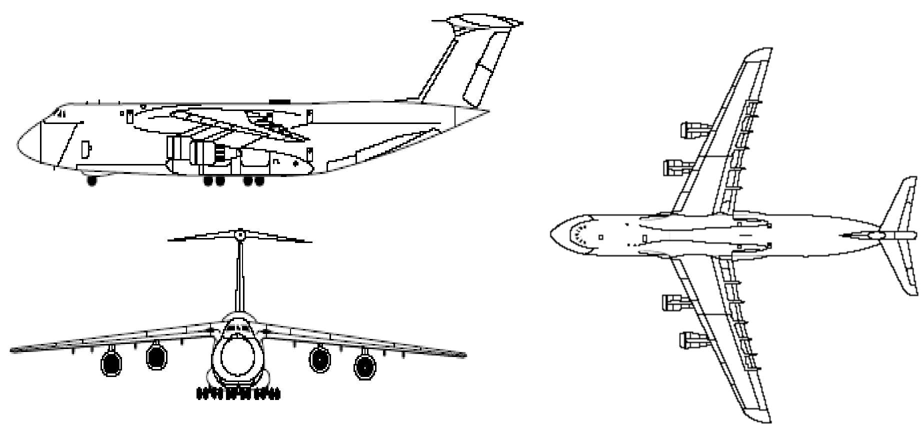


FIGURE 6.4. C-5 Galaxy

KC-46 Pegasus

Radar Pattern Speed:
200 KIAS
Final Approach Speed: 150 KIAS

FIGURE 6.5. KC-46 Pegasus

7. VISION AND SCANNING TECHNIQUES

7.1. FACTORS AFFECTING VISION: The sense of sight is essential to avoiding other aircraft, yet our eyes have limitations, just as our aircraft do. Being aware of these limitations could improve your ability to see and avoid.

A. **Blind Spots:** The human eye has a blind spot where light strikes the optic nerve. The location of the blind spot for most people is about 30 degrees right of center. With both eyes unobstructed, the blind spots of each eye are canceled out by the peripheral vision of the other eye. However, put a windshield center post or other type obstruction between the eyes and the brain cannot fill the void. Under certain conditions, a Boeing 707 would be blocked out at a distance of one mile and a Boeing 747 would disappear at a mile and a half. At night, the eye's central vision is degraded and peripheral vision, which is not as effective as central vision, must be used to detect relative motion.

B. **Fixation:** At high altitudes, in the absence of objects to focus on, (horizon, clouds, etc.) the eyes tend to focus on the windscreen or just outside the cockpit. This tendency for fixation must be avoided. Scan in sectors, shift gaze vertically as well as horizontally; try to practice focusing on objects of known or accurately estimable distances (instrument panel, wing tips and distant objects) when available to 'reset' your distance gauge.

C. **Focus:** The time required for the eyes to change their focus from one object to another (accommodation time) is at least 2 seconds, or about the same time it takes to change focus from the instrument panel to outside the aircraft. This time increases with fatigue and age.

D. **Contrast:** Contrast of objects is very important in avoiding another aircraft. The aircraft that contrasts with its background is much easier to detect than one that blends in with its background, especially during low-light illumination. Sky conditions on many occasions make it much more difficult to detect another aircraft. If there is a lack of contrast, the aircraft must come closer in order to be detected, thus creating the danger of an in-flight collision. At high altitudes, more light comes from the atmosphere below than from above, flooding the eyes. This makes the cockpit appear quite dark in contrast to the outside.

E. **Near-Sightedness:** The normal eye with 20/20 vision can detect an aircraft with a fuselage diameter of two meters from about six kilometers away. If you are nearsighted (myopic) you will not be able to see the aircraft until it is closer. How close depends on how nearsighted you are. The more severe the myopia, the closer the aircraft will be before it is detected. If glasses are prescribed you should wear them for safety's sake.

F. **Glare:** Glare over-stimulates the eyes and causes a loss of sensitivity which reduces the ability of the eye to see objects under normal light conditions. Glare may be produced from the light striking the windscreen or the instrument panel at an angle. Blinding glare can be caused by scanning when the pilot looks directly into the sun, causing a temporary haze over the visual field.

G. **Lack of Relative Motion:** Lack of relative motion results in more time needed for the eyes to spot another aircraft. If an aircraft is on a head-on collision course, it will appear to be motionless. If you are directly overtaking another aircraft, it will also appear motionless. An object that moves across the windscreen will be much more rapidly detected. You must perform some type of evasive maneuver to cause the apparent collision aircraft to move in some direction on your windscreen.

H. **Hypoxia:** Hypoxia can affect the ability of the eyes to detect distant objects, especially at night. Due to the lack of oxygen in the blood, the eyes suffer a loss of acuity and have difficulty in focusing. A smoker must be especially aware of this factor. A smoker's blood is carrying carbon monoxide which displaces some of the oxygen and makes the effects of hypoxia take place sooner.

I. **Turbulence/Vibration:** In extreme cases, turbulence or vibration can cause deterioration in vision. It can also cause fatigue which further degrades the ability of our eyes and our alertness.

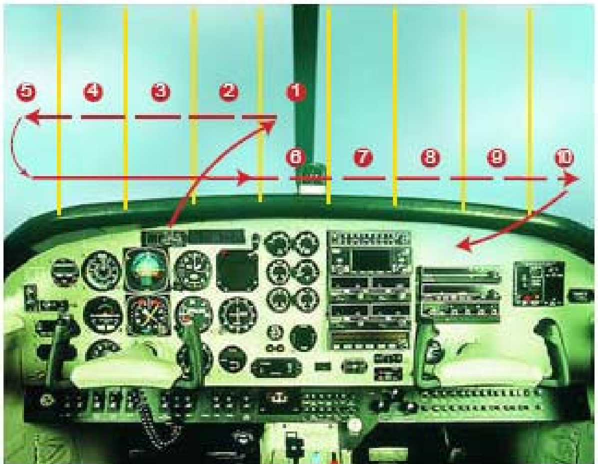
J. **Reaction Time:** The time to perceive and recognize an aircraft, become aware of a collision potential, and decide on an appropriate action, may vary from as little as two or three seconds to 10 seconds or more, depending on the human, type of aircraft, and geometry of the closing situation. On top of this, aircraft reaction time must be added. Remember that any evasive action contemplated should include maintaining visual contact with the other aircraft if possible.

7.2. SCANNING: Where and how you look is important too. You can see an aircraft at the greatest distance by looking directly at it (daytime). If you see it 5 miles away, you can avoid it, even head on at Mach 1 closure. However, if the aircraft is only 10 degrees to the side while you're looking straight ahead, your eyes can't pick it up until about one-tenth the distance (1/2 mile)!

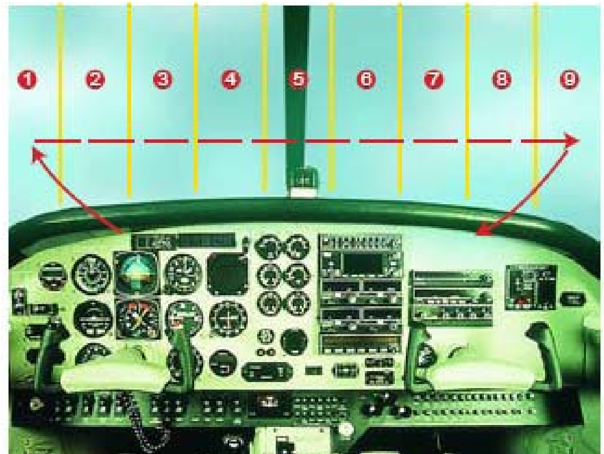
Have you ever looked straight at something and not seen it? When the eyes have no definite images to focus on (such as a clear sky), they tend to focus at three to four feet. This phenomenon, known as *empty field myopia*, results in distant objects fading out. One effective method in overcoming, this problem is to mentally divide the sky (windscreen) into sectors similar to a checkerboard (see Figure 7.1). Then, purposefully focus your eyes into the center of each sector long enough for your eyes to adjust. This method requires a certain amount of effort, but it will help in preventing a "lazy gaze".

Two scanning methods that have proved to be effective for pilots involve the "block" system of scanning, which is based on the theory that "traffic detection can be made only through a series of eye fixations at different points in space." In application, the viewing area (windshield) is divided into segments, and the pilot methodically scans for traffic in each block of airspace in sequential order.

FIGURE 7.1 Scanning Methods



Example 1: The center-to-side pattern involves moving the eyes methodically from the center of the visual field to the far left. The eyes briefly return to the center and move right. This is followed by a brief scan of the instrument panel before the process is repeated.



Example 2: The side-to-side pattern involves moving the eyes methodically from the far left of the visual field to the far right, pausing very briefly in each block of the viewing area to focus. This is followed by a brief scan of the instrument panel before the process is repeated.

Photo Credit: Flight Safety Australia, September-October 2004

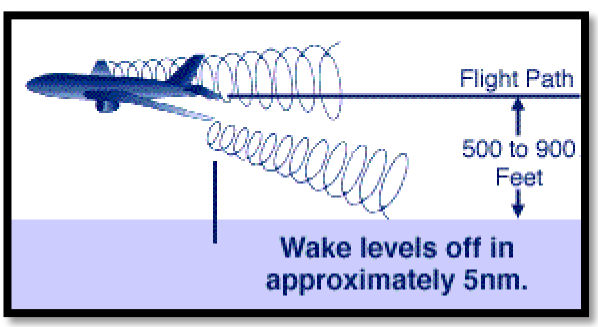
8. WAKE TURBULENCE AVOIDANCE

8.1. WAKE TURBULENCE: Wake turbulence is a vortex created by any wing producing lift. The vortex trails the wing tips and spreads outwards and downwards at 500 feet per minute. All aircraft produce some degree of wake turbulence. During one test, vortex velocities were recorded at 300 feet per second (approximately 180 knots). **The greatest vortex occurs when the generating aircraft is HEAVY, CLEAN, and SLOW**. Cargo aircraft and passenger airliners produce powerful wake turbulence that could have a dramatic effect on the unsuspecting pilot. Here are some good rules of thumb for avoiding wake turbulence:

A. Cruise Flight: During cruise, avoid flying directly behind and below other aircraft. Flight tests have shown that the vortices from heavy jets start to sink immediately at about 400-500 feet per minute. They then tend to level off about 800-900 feet below the generating aircraft's flight path and can remain as far as 10 miles behind a heavy aircraft flying at slow to moderate speed (such as in IFR holding patterns).

B. Traffic Pattern: During landing, fly your approach above the heavy aircraft and land beyond the point where the aircraft lowers its nose to the runway; during takeoff, liftoff before the rotation point of the heavy aircraft and climb above its flight path. Allow adequate time separation between yourself and the aircraft in front of you, even if traveling perpendicular to its flight path. When the vortices sink into ground effect, they tend to move laterally outward over the ground at a speed of about five knots. A crosswind component will decrease the lateral movement of the upwind vortex and increase the movement of the downwind vortex. This may result in the upwind vortex remaining in the touchdown zone or hasten the drift of the downwind vortex toward a parallel runway. Similarly, a tail wind condition can move the vortices of the preceding aircraft forward into the touchdown zone.

FIGURE 8.1

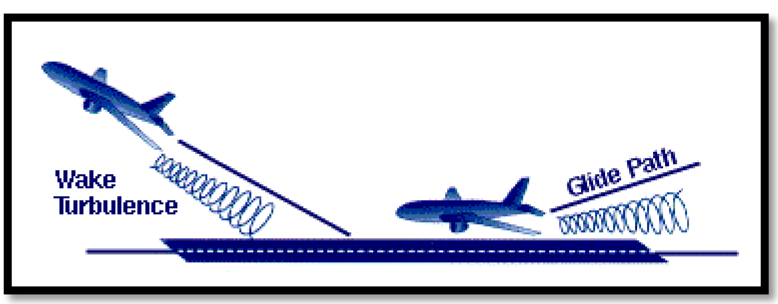


8.2. AERONAUTICAL INFORMATION MANUAL GUIDELINES: Remember that wake turbulence can be so severe as to cause loss of aircraft control or catastrophic structural failure. The KC-135 and C-17 are designated as "Heavy" aircraft and the following time and distance intervals, as suggested by the Aeronautical Information Manual, should be maintained to ensure safe flight:

The following vortex avoidance procedures are recommended for the various situations:

1. **Landing behind a larger aircraft- same runway.** Stay at or above the larger aircraft's final approach flight path-note its touchdown point-land beyond it.
2. **Landing behind a larger aircraft- when parallel runway is closer than 2,500 feet.** Consider possible drift to your runway. Stay at or above the larger aircraft's final approach flight path- note its touchdown point.
3. **Landing behind a larger aircraft- crossing runway.** Cross above the larger aircraft's flight path.
4. **Landing behind a departing larger aircraft- same runway.** Note the larger aircraft's rotation point- land well prior to rotation point.
5. **Landing behind a departing larger aircraft- crossing runway.** Note the larger aircraft's rotation point- if past the intersection- continue the approach- land prior to the intersection. If larger aircraft rotates prior to the intersection, avoid flight below the larger aircraft's flight path. Abandon the approach unless a landing is ensured well before reaching the intersection.
6. **Departing behind a larger aircraft.** Note the larger aircraft's rotation point and rotate prior to the larger aircraft's rotation point. Continue climbing above the larger aircraft's climb path until turning clear of the larger aircraft's wake. Avoid subsequent headings which will cross below and behind a larger aircraft. Be alert for any critical takeoff situation which could lead to a vortex encounter.
7. **Intersection takeoffs- same runway.** Be alert to adjacent larger aircraft operations, particularly upwind of your runway. If intersection takeoff clearance is received, avoid subsequent heading which will cross below a larger aircraft's path.
8. **Departing or landing after a larger aircraft executing a low approach, missed approach, or touch-and-go landing.** Because vortices settle and move laterally near the ground, the vortex hazard may exist along the runway and in your flight path after a larger aircraft has executed a low approach, missed approach, or a touch-and-go landing, particular in light quartering wind conditions. You should ensure that an interval of at least 2 minutes has elapsed before your takeoff or landing.
9. **En route VFR (thousand-foot altitude plus 500 feet).** Avoid flight below and behind a large aircraft's path. If a larger aircraft is observed above on the same track (meeting or overtaking) adjust your position laterally, preferably upwind.

Figure 8.2



9. MID-AIR COLLISION AVOIDANCE CHECKLIST

9.1. CHECK YOURSELF: Start with a check of your own condition. Your safety depends on your mental and physical condition. Just as a checklist is used when preflighting an airplane, a personal checklist based on such factors as experience, currency and comfort level can help you determine if you are ready to fly. Utilizing the "I'M SAFE" aid (Illness, Medication, Stress, Alcohol, Fatigue, and Emotion) and identifying whether your personal minimums for flying might be higher than regulations require are all part of your preflight activities.

9.2. PLAN AHEAD: Plan your flight ahead of time. Have charts folded in proper sequence and within reach (EFB has necessary information downloaded). Keep your cockpit free of clutter. Be familiar with headings, frequencies, distances, etc., so you spend minimal time with your head down in the charts. Some pilots even jot these things down on a flight log before takeoff. Check your maps and the special, general, and area notices in the AIM in advance for restricted areas, jet training areas, military training routes and other high-density areas. If you don't want to be escorted by some of the world's finest fighter aircraft, be sure to check the latest temporary flight restrictions (TFR); this has become a very hot item since September 11, 2001.

9.3. CLEAN WINDOWS: During the walk around, make sure your windshield is clean. If possible, keep all windows clear of obstructions. Even small bug spots can block or distract your view of an approaching aircraft in your flight path.

9.4. ADHERE TO SOP's: Stick to standard operating procedures and observe the regulations of flight, such as correct altitudes and proper pattern practices. If you're unable to maintain your assigned altitude and route of flight, get an amended clearance. In most in-flight collisions, at least one of the pilots involved was not where he or she was supposed to be.

9.5. AVOID CROWDS: Avoid congested airspace reroute. You can navigate on VFR days just as accurately by passing slightly to the right of VOR stations rather than directly overhead. Pass over airports at a safe altitude, being particularly careful within a 25-mile radius of congested military and civilian fields.

9.6. COMPLETE CHECKLISTS EARLY: Complete checklists prior to descent if possible, before reaching the crowded lower altitudes. For departure and arrival try interspersing checklist items with deliberate outside looks.

9.7. COMPENSATE FOR DESIGN: Compensate for your aircraft's design limitations. All planes have blind spots – know yours! A mid-air potential is a fast low-wing plane on final approach.

9.8. EQUIP FOR SAFETY: Your airplane can, in fact, help avoid collisions. Certain equipment, once priced out of the markets for light aircraft owners, is now available at a reasonable cost. High intensity strobe lights, transponders and traffic alerting systems are just some examples of equipment that can increase your safety margin. Also, ensure that your equipment is on and operating properly.

9.9. TALK AND LISTEN: Use your radios as well as your eyes. When approaching an airport, whether you're going to land or not, call on the appropriate frequency at least 15 miles out and relay your position, altitude, and intentions. Since detecting a small aircraft at a distance is not easy, make use of any hints you get over the radio. A pilot reporting his or her position to a tower is also reporting to you. Once you have that particular traffic in sight, don't forget the rest of the sky. Use of VHF frequencies, if capable, will greatly increase situational awareness in the vicinity of civilian airfields.

9.10. SCAN, SCAN, SCAN! Watch for traffic! Scan continuously! Basically, if you use sound airmanship, keep yourself and your aircraft in good shape and develop an effective scanning technique, you will have no trouble avoiding in-flight collisions. *Keep your eyes outside!*