Eye on the sky

ILLUSTRATION: MERRAN WILLIAMS

Better scanning techniques will help pilots avoid mid-air collisions.

SO YOU WANT to know what the perfect scan is? There isn't one, or at least there is no one scan that is best for all pilots. Pilots need to develop a scan that is comfortable and workable for them in their own aeroplanes.

The best way to start is by getting rid of bad habits. Failing to look out is the poorest scan technique, but glancing out at intervals of five minutes or so is also poor, given that it takes only seconds for a disaster to happen. Check yourself the next time you're climbing out, making an approach, or just flying cross-country. See how long you go without looking out the window.

Glancing out and giving it the once-around without stopping to focus on anything is practically useless. So is staring at one spot for long periods (even though it might be great for meditation).

> **Your eyes can play some nasty tricks on you - things aren't always what they seem."**

Learn how to scan properly by knowing where to concentrate your search. It would be better to look everywhere but, as that's impractical, concentrate on the areas most critical to you at the time.

In the circuit area especially, clear the area before every turn and always watch for traffic making an improper entry into the pattern. On descent and climbout, make gentle S-turns, if possible, to see if anyone is in your way. Always make clearing turns before attempting unusual manoeuvres.

During that very critical final approach stage, avoid tunnel vision. Pilots often rivet their eyes to the point of touchdown. In normal flight you can generally avoid the threat of an in-flight collision by scanning an area 60 degrees to the left and right of your centre of vision.

This doesn't mean you should forget the rest of the area you can see from your side windows every few scans. Statistics indicate that you will be safe if you scan 10 degrees up and down from your flight path. This will allow you to spot any aircraft that is at an altitude that might conflict with your own flight path, whether it's level with you, below and climbing, or above and descending.

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Scan patterns The best defence against in-flight collisions is an efficient scan pattern. Two basic methods that have proved best for most pilots use the "block" system of scanning. This type of scan is based on the theory that traffic detection can be made only through a series of eye fixations at different points in space. Each of these fixes becomes the focal point of your field of vision (a block 10–15 degrees wide). By fixating every 10–15 degrees, you should be able to detect any contrasting or moving object in each block. This gives you 9–12 "blocks" in your scan area, each requiring at least one to two seconds for accommodation and detection.

One method of block scanning is the "side-to-side" motion. Start at the far left of your visual area and make a methodical sweep to the right, pausing in each block to focus. At the end of the scan, return to the panel.

The second form is the "front-to-side" version. Start with a fixation in the centre block of your visual field (approximately the centre of the front windshield in front of the pilot). Move your eyes to the left, focusing in each block, swing quickly back to the centre block and repeat the procedure to the right.

Fixations There are other methods of scanning, some of which you might find as effective as these. However, unless some series of fixations is made, there is little likelihood that you will be able to detect all the targets in your scan area. When the head is in motion, vision is blurred and the mind will not register targets.

External scanning is part of the pilot's total scanning job. To achieve maximum efficiency in flight, you have to establish a good internal (panel) scan and learn to give each its proper share of time. The amount of time spent looking outside the cockpit in relation to time spent looking inside depends on the workload inside the cockpit and the density of traffic outside. Generally, the external scan will take about three to four times as long as a look around the instrument panel.

Using military pilots ranging in experience from 350 to 4,000 hours, McDonnell Douglas conducted an experimental scan training course. Its researchers discovered that the average time devoted to scanning was three seconds for panel scan and 17 seconds for outside.

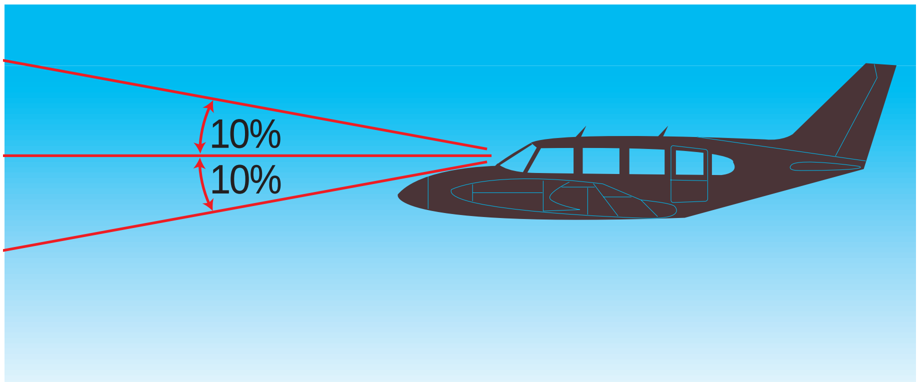
Panel scan An efficient instrument scan is good practice, even if you are operating in visual meteorological conditions. Being able to quickly scan the panel gives pilots a better chance of doing an effective job outside as well.

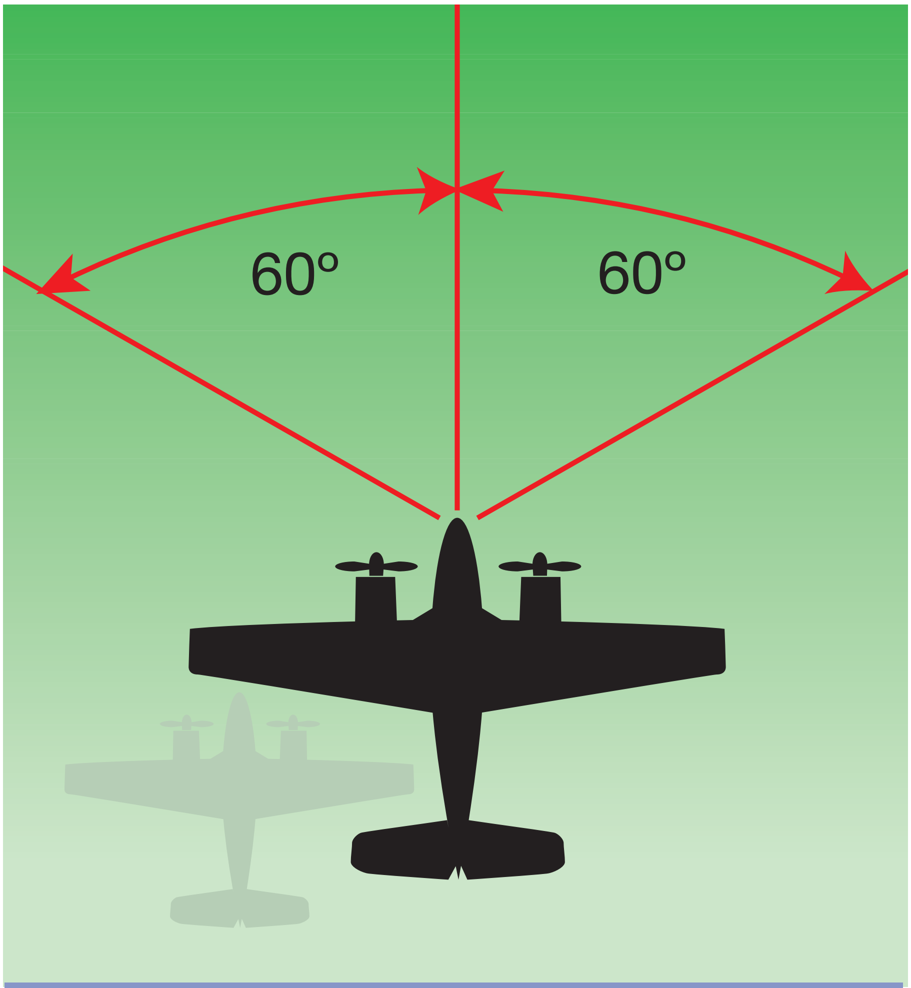
Developing an efficient time-sharing plan takes a lot of work and practice, but it is just as important as developing good landing techniques. The best way is to start on the ground, in your own aeroplane or the one you usually fly, and then practice your scans during every flight.

Passengers Although your passengers might not be pilots, they can help you in your responsibility to "see and avoid". Take a few moments to brief them on the importance of detecting traffic and, if possible, acquaint them with the rudiments of scanning.

Explain how to relate traffic position with respect to the clock and encourage them to report all the traffic they see. This will invariably result in a few false alarms but the potential payoffs are worth the inconvenience.If you develop an effective time-sharing scan, you'll have no trouble avoiding in-flight collisions.

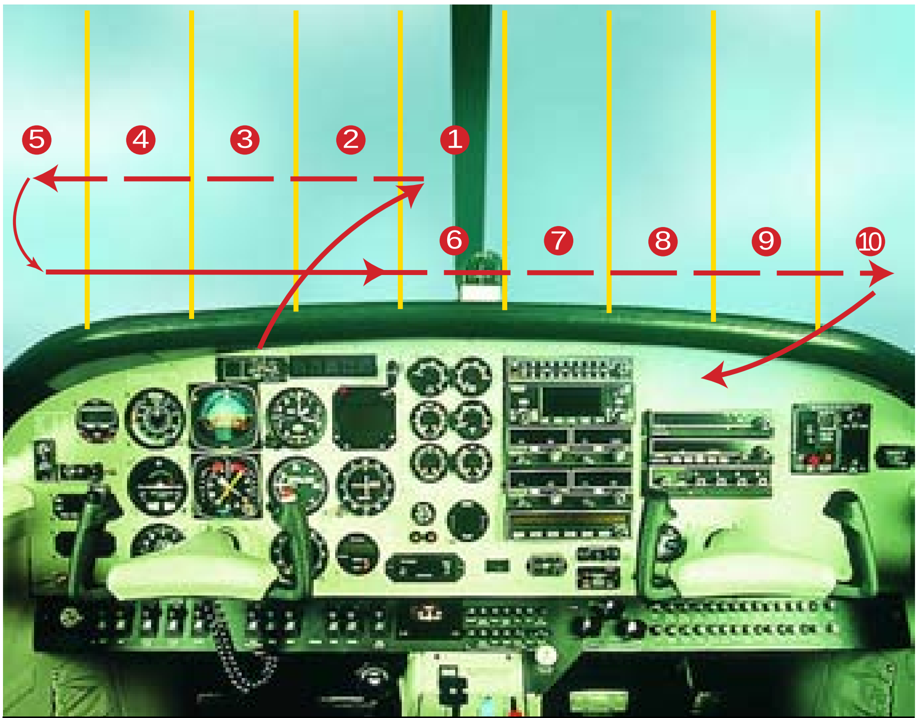
Adapted from How to Avoid a Mid-air Collision, AOPA Air Safety Foundation



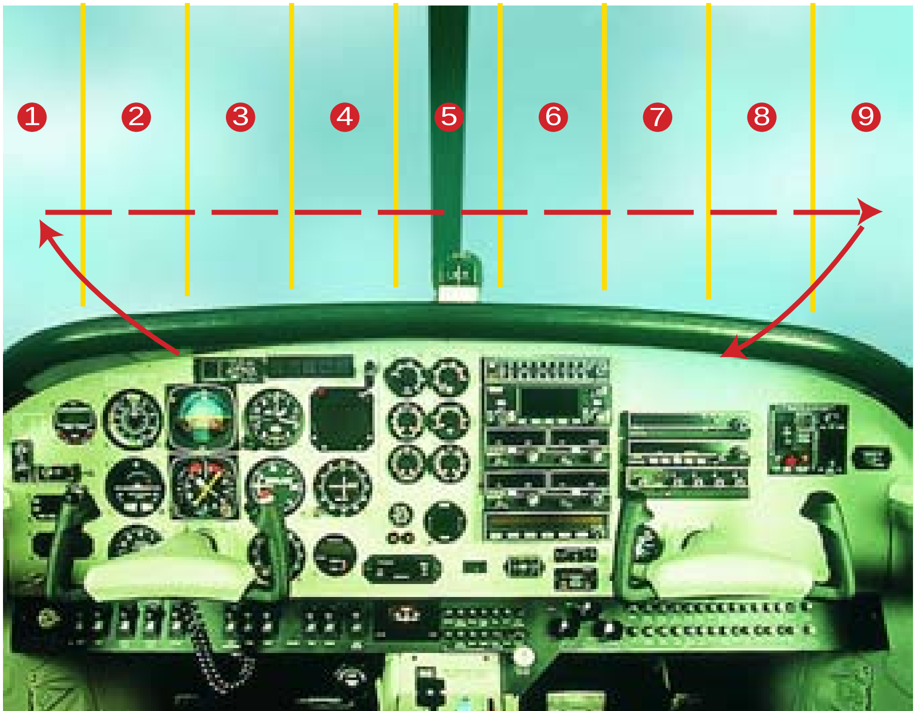


The threat of mid-air collision can be reduced by scanning 60 degrees to the left and right and 10 degrees up and down.

Scanning techniques



Example 1 The centre-to-side pattern involves moving the eyes methodically from the centre of the visual field to the far left. The eyes then return to the centre 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.

Putting the focus on vision

VISION IS vulnerable to just about everything: dust; fatigue; emotion; germs; fallen eyelashes; age; optical illusions and the number of drinks consumed at last night's party. In flight, our vision is altered by factors including atmospheric conditions, windshield distortion, too much oxygen or too little, acceleration, glare, heat, lighting and aircraft design.

Most of all, the eye is vulnerable to the vagaries of the mind. We can "see" and identify only what the mind lets us see. A daydreaming pilot staring out into space sees no approaching traffic and is probably the number one candidate for an in-flight collision.

One function of the eye that is a source of constant problems to the pilot (though he or she is probably never aware of it) is the time required for accommodation. Our eyes automatically accommodate for (or refocus on) near and far objects.

But the change from something up close, like a dark panel two feet away, to a well-lit landmark or an aircraft target a mile or so away takes at least one to two seconds for eye accommodation. That's a long time, given that you need about 10 seconds to avoid in-fight collisions.

Another focusing problem usually occurs at very high altitudes but it can happen at lower levels on vague, colourless days above a haze or cloud layer when no distinct horizon is visible. If there is little or nothing to focus on at infinity, we do not focus at all.

We experience "empty-field myopia" – staring but seeing nothing, even approaching traffic. The National Transportation Safety Board (NTSB) has studied the effects of "binocular vision" during investigations of in-flight collisions, with the conclusion that this is also a causal factor. To accept what we see, we need to receive cues from both eyes. If an object is visible to one eye but hidden from the other by a windshield post or other obstruction, the total image is blurred and not always acceptable to the mind.

Another inherent eye problem is that of narrow field of vision. Although our eyes accept light rays from an arc of nearly 200 degrees, they are limited to a relatively limited area (approximately 10 to 15 degrees) in which they can actually focus on and classify an object.

Though we can perceive movement in the periphery, we cannot identify what is happening out there. We tend not to believe what we see out of the corner of our eyes. This, aided by the brain, often leads to "tunnel vision".

This limitation is compounded by the fact that at a distance, an aircraft on a collision course with you will appear motionless. It will remain in a seemingly stationary position, without appearing either to move or grow in size for a relatively long time, and then suddenly bloom into a huge mass filling one of your windows. This is known as "blossom effect". Since we need motion or contrast to attract our eyes' attention, this becomes a frightening factor when you realise that a large bug smear or dirty spot on the windshield can hide a converging plane until it is too close to be avoided.

Also be aware that fashion sunglasses can be useless in reducing glare and in some cases, can obstruct clear vision.

The eye is also limited by environment. Optical properties of the atmosphere alter the appearance of traffic, particularly on hazy days. "Limited visibility" actually means, "limited vision". You may be legally VFR when you have five kilometres of visibility, but at that distance on a hazy day, opposing traffic is difficult to detect. At a range closer than five kilometres – even though detectable – an aeroplane on a collision course may not be avoidable.

Lighting also affects our vision. Glare, usually worse on a sunny day over a cloud deck or during flight directly into sun, makes objects hard to see and scanning uncomfortable. And an object that is well lit, will have a high degree of contrast and will be easy to detect. One with low contrast at the same distance may be impossible to see. For instance, when the sun is behind you, an opposing aircraft will stand out clearly, but when you're looking into the sun and your traffic is "backlit", it's a different story.

Another contrast problem is trying to find an aeroplane over a cluttered background. If it is between you and terrain that is vari-coloured or heavily dotted with buildings, it will blend into the background until it is quite close.

And of course, there is the mind, which can distract us to the point of not seeing anything at all, or lull us into cockpit myopia – staring at one instrument without "seeing" it. How often have you been IFR on a CAVOK day, settled back at your assigned altitude with autopilot on and then never looked outside, secure that the radar advisory service will protect you from all harm?

Perception is affected by many factors. It all boils down to the fact that pilots, like anyone else, tend to over estimate their visual abilities and to misunderstand their eyes' limitations. Since the number one cause of in-flight collisions is the failure to properly adhere to the see-and-avoid concept, we can conclude that the best way to avoid them is to learn how to use our eyes in an efficient external scan.

Adapted from "How to Avoid a Mid-air Collision", AOPA Air Safety Foundation.