

## Chapter 13

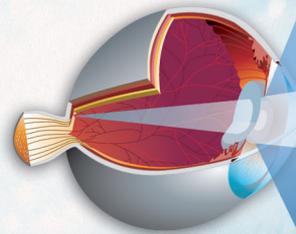
# Night Operations

### Introduction

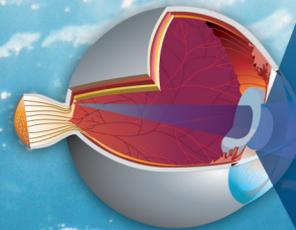
Pilots rely more on vision than on any other sense to orient themselves in flight. The following visual factors contribute to flying performance: good depth perception for safe landings, good visual acuity to identify terrain features and obstacles in the flightpath, and good color vision. Although vision is the most accurate and reliable sense, visual cues can be misleading, contributing to incidents occurring within the flight environment. Pilots must be aware of and know how to compensate effectively for the following:

- Physical deficiency or self-imposed stress, such as smoking, which limits night-vision capability
- Visual cue deficiencies
- Limitations in visual acuity, dark adaptation, and color and depth perception

For example, at night, the unaided eye has degraded visual acuity. For more information on night operations reference Chapter 16, pages 16-20 of the Pilots Handbook of Aeronautical Knowledge.

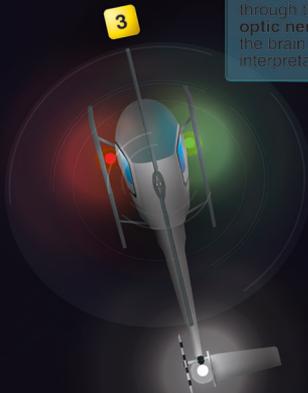
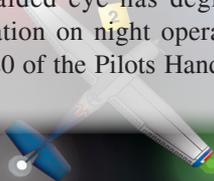
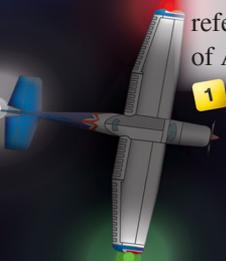


Cones active

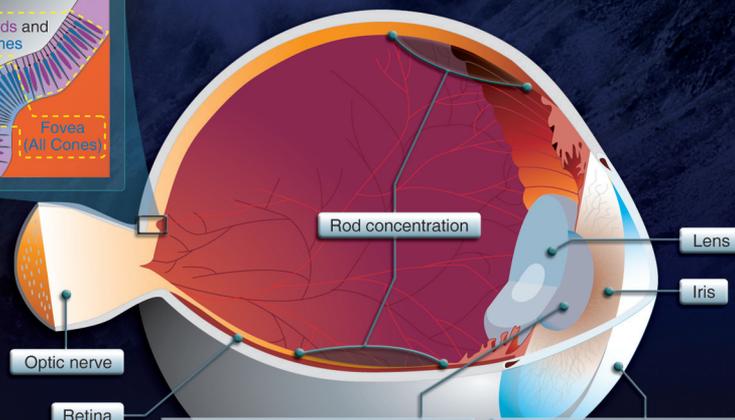
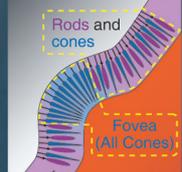


Night blind spot

Rods active



The rods and cones (film) of the retina are the receptors which record the image and transmit it through the optic nerve to the brain for interpretation.



The **pupil** (aperture) is the opening at the center of the **iris**. The size of the pupil is adjusted to control the amount of light entering the eye.

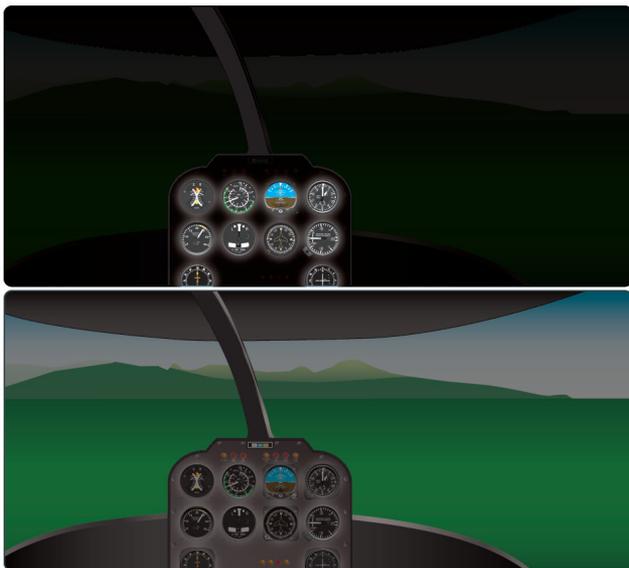
Light passes through the **cornea** (the transparent window on the front of the eye) and then through the **lens** to focus on the retina.

## Visual Deficiencies

### Night Myopia

At night, blue wavelengths of light prevail in the visible portion of the spectrum. Therefore, slightly nearsighted (myopic) individuals viewing blue-green light at night may experience blurred vision. Even pilots with perfect vision find that image sharpness decreases as pupil diameter increases. For individuals with mild refractive errors, these factors combine to make vision unacceptably blurred unless they wear corrective glasses. Another factor to consider is “dark focus.” When light levels decrease, the focusing mechanism of the eye may move toward a resting position and make the eye more myopic. These factors become important when pilots rely on terrain features during unaided night flights. Practicing good light discipline is very important and helps pilots to retain their night adaptation. Keeping the cockpit lighting on dim allows the pilot to better identify outside details, unmarked hazards such as towers less than 200' AGL, and unimproved landing sites with no hazard lighting.

A simple exercise that shows the difference in light contrast would be to go out to a very dark road and turn the dash board lights down very low or off and let your eyes adjust to the ambient light level. Then, turn the dash board lights up and note how the outside features disappear. The same concept applies to cockpit lighting and being able to see the surrounding terrain and obstacles. [Figure 13-1] Special corrective lenses can be prescribed to pilots who experience night myopia .



**Figure 13-1.** Effects of dimming cockpit lighting during night flight to better see surrounding terrain.

### Hyperopia

Hyperopia is also caused by an error in refraction. In a hyperopic state, when a pilot views a near image, the actual focal point of the eye is behind the retinal plane (wall), causing blurred vision. Objects that are nearby are not seen clearly; only more distant objects are in focus. This problem, is referred to as farsightedness.

### Astigmatism

An unequal curvature of the cornea or lens of the eye causes this condition. A ray of light is spread over a diffused area in one meridian. In normal vision, a ray of light is sharply focused on the retina. Astigmatism is the inability to focus different meridians simultaneously. If, for example, astigmatic individuals focus on power poles (vertical), the wires (horizontal) are out of focus for most of them. [Figure 13-2]

### Presbyopia

This condition is part of the normal aging process, which causes the lens to harden. Beginning in the early teens, the human eye gradually loses the ability to accommodate for and focus on nearby objects. When people are about 40 years old, their eyes are unable to focus at normal reading distances without reading glasses. Reduced illumination interferes with focus depth and accommodation ability. Hardening of the lens may also result in clouding of the lens (cataract formation). Aviators with early cataracts may see a standard eye chart clearly under normal daylight but have difficulty seeing under bright light conditions. This problem is due to light scattering as it enters the eye. This glare sensitivity is disabling under certain circumstances. Glare disability, related to contrast sensitivity, is the ability to detect objects against varying shades of backgrounds. Other visual functions decline with age and affect the aircrew member's performance:

- Dynamic acuity
- Recovery from glare
- Function under low illumination
- Information processing

## Vision in Flight

The visual sense is especially important in collision avoidance and depth perception. A pilot's vision sensors are the eyes, even though they are not perfect in the way they function. Due to the structure of the human eye, illusions and blindspots occur. The more pilots understand the eye and how it functions, the easier it is to compensate for these illusions and blindspots. Figure 13-3 shows the basic anatomy of the

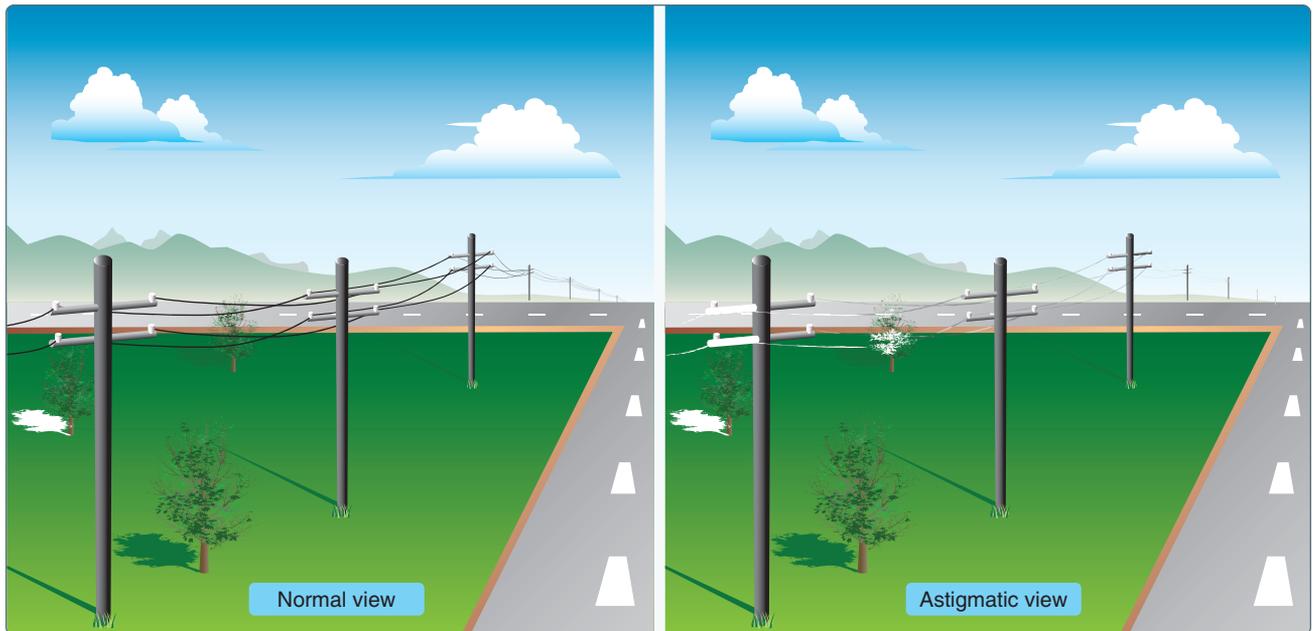


Figure 13-2. Example of a view that might be experienced by someone with astigmatism.

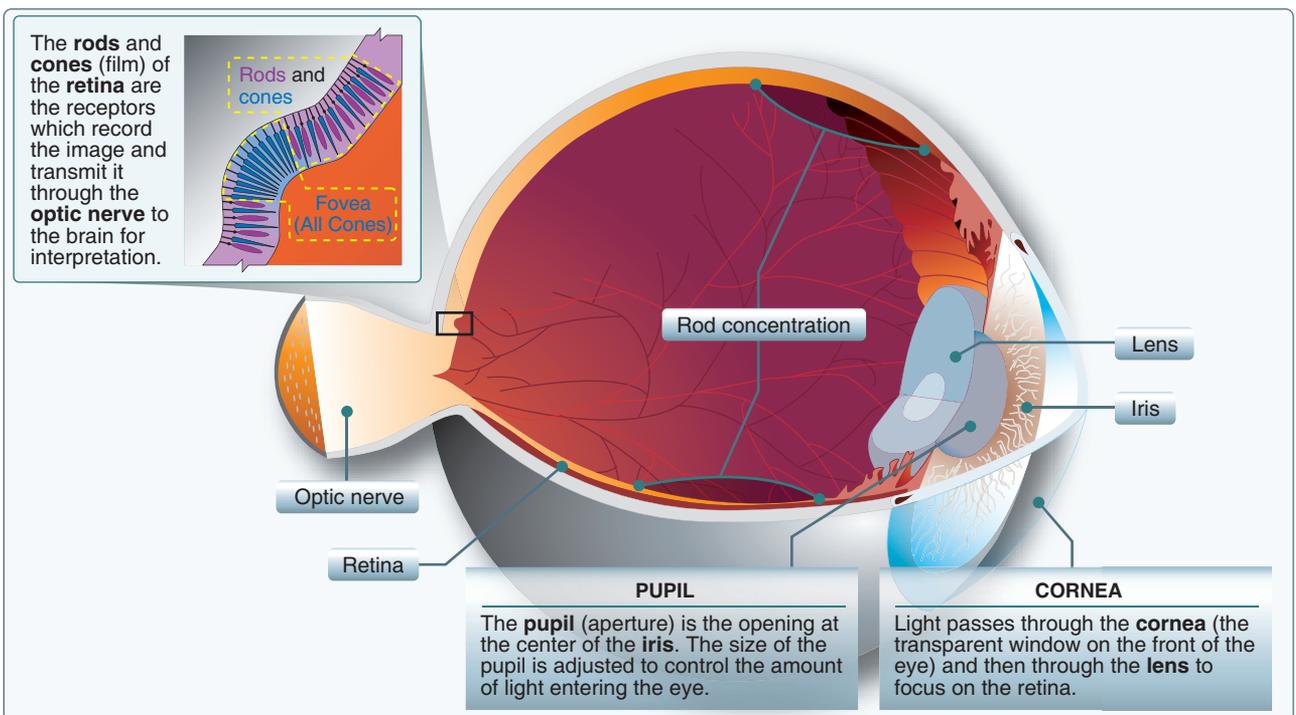


Figure 13-3. The human eye.

human eye and how it is like a camera. A camera is able to focus on near and far objects by changing the distance between the lens and the film. Objects can be seen clearly at various distances because the shape of the eye's lens is changed automatically by small muscles.

### Visual Acuity

Normal visual acuity, or sharpness, is 20/20. A value of 20/80 indicates that an individual reads at 20 feet the letters that an individual with normal acuity (20/20) reads at 80 feet away. The human eye functions like a camera. It has

an instantaneous field of view, which is oval and typically measures 120° vertically by 150° horizontally. When both eyes are used for viewing, the overall field of vision measures about 120° vertically by 200° horizontally.

The eye automatically adjusts for the light level experienced. During night flight, the cockpit and instrument lights should be as dim as possible. The eye can then adjust for the outside lighting conditions (ambient lighting) to see outside. The dimmer the inside lighting is, the better you can see outside.

## The Eye

Vision is primarily the result of light striking a photosensitive layer, called the retina, at the back of the eye. The retina is composed of light-sensitive cones and rods. The cones in the eye perceive an image best when the light is bright, while the rods work best in low light. The pattern of light that strikes the cones and rods is transmitted as electrical impulses by the optic nerve to the brain where these signals are interpreted as an image.

### Cones

Cones are concentrated around the center of the retina. They gradually diminish in number as the distance from the center increases. Cones allow color perception by sensing red, blue, and green light. Directly behind the lens, on the retina, is a small, notched area called the fovea. This area contains only a high concentration of cone receptors. The best vision in daylight is obtained by looking directly at the object. This focuses the image on the fovea, where detail is best seen. The cones, however, do not function well in darkness, which explains why color is not seen as vividly at night as it is during the day.

### Rods

Concentrated outside the fovea area, the rods are the dim light and night receptors. The number of rods increases as the distance from the fovea increases. Rods sense images only in black and white. Because the rods are not located directly

behind the pupil, they are responsible for most peripheral vision. Images that move are perceived more easily by the rod areas than by the cones in the fovea. If you have ever seen something move out of the corner of your eye, it was most likely detected by rod receptors.

In low light, the cones lose much of their function, while rods become more receptive. The eye sacrifices sharpness for sensitivity. The ability to see an object directly in front of you is reduced, and much depth perception is lost, as well as judgment of size. The concentration of cones in the fovea can make a night blindspot at the center of vision. How well a person sees at night is determined by the rods in the eyes, as well as the amount of light allowed into the eyes. The wider the pupil is open at night, the better night vision becomes.

## Night Vision

Diet and general physical health have an impact on how well a person can see in the dark. Deficiencies in vitamins A and C have been shown to reduce night acuity. Other factors, such as carbon monoxide poisoning, smoking, alcohol, and certain drugs can greatly decrease night vision. Lack of oxygen can also decrease night vision as the eye requires more oxygen per weight than any other part of the body.

### Night Scanning

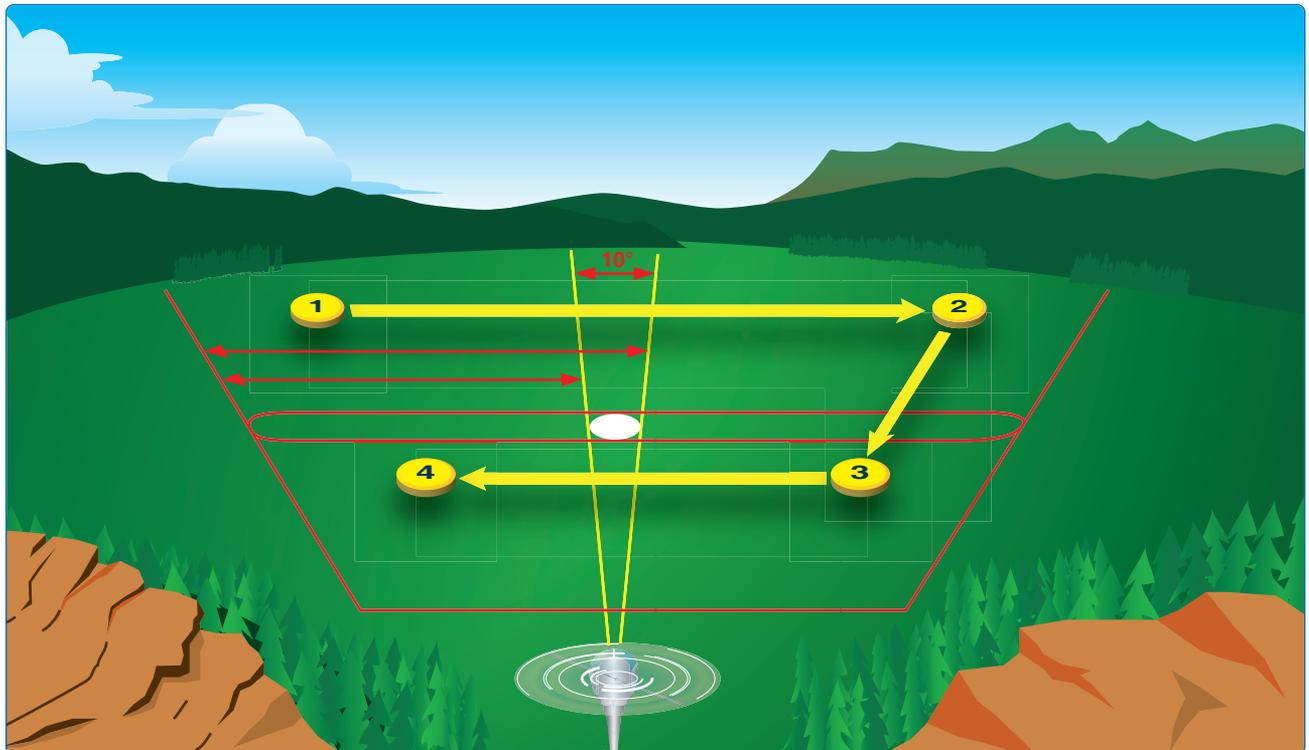
Good night visual acuity is needed for collision avoidance. Night scanning, like day scanning, uses a series of short, regularly spaced eye movements in 10° sectors. Unlike day scanning, however, off-center viewing is used to focus objects on the rods rather than the fovea blindspot. [Figure 13-4] When looking at an object, avoid staring at it too long. If staring at an object without moving the eyes, the retina becomes accustomed to the light intensity and the image begins to fade. To keep it clearly visible, new areas in the retina must be exposed to the image. Small, circular eye movements help eliminate the fading. Also, move the eyes more slowly from sector to sector than during the day to prevent blurring.



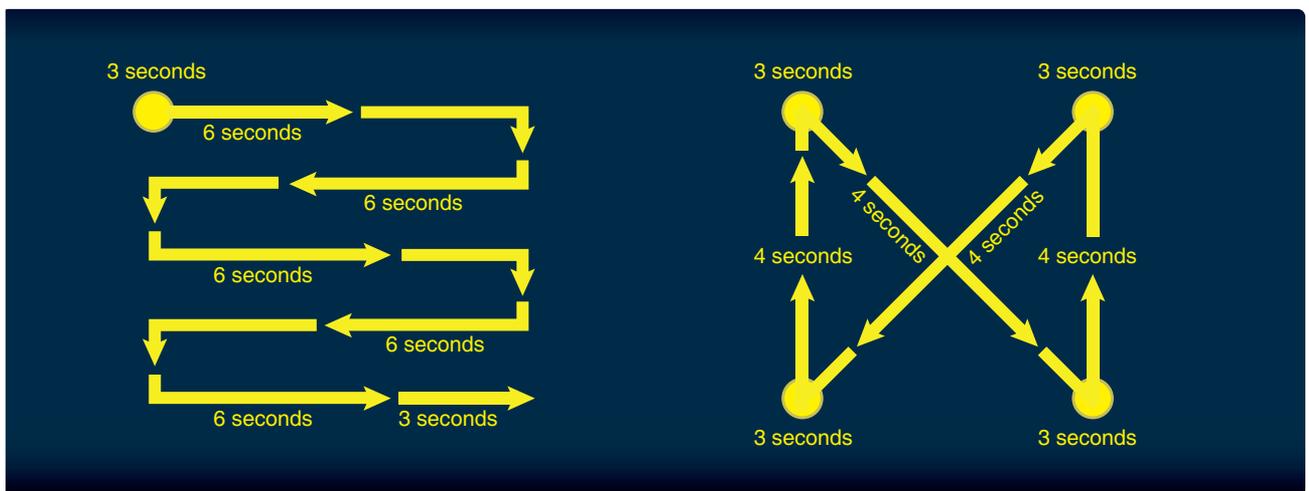
Figure 13-4. Off-center vision technique.

During daylight, objects can be perceived at a great distance with good detail. At night, range is limited and detail is poor. Objects along the flight path can be more readily identified at night when pilots use the proper techniques to scan the terrain. To scan effectively, pilots look from right to left or left to right. They should begin scanning at the greatest distance at which an object can be perceived (top) and move inward toward the position of the aircraft (bottom). *Figure 13-5* shows this scanning pattern. Because the light-sensitive elements of the retina are unable to perceive images that are in motion, a stop-turn-stop-turn motion should be used. For

each stop, an area about 30 degrees wide should be scanned. This viewing angle includes an area about 250 meters wide at a distance of 500 meters. The duration of each stop is based on the degree of detail that is required, but no stop should last more than two or three seconds. When moving from one viewing point to the next, pilots should overlap the previous field of view by 10 degrees. This scanning technique allows greater clarity in observing the periphery. Other scanning techniques, as illustrated in *Figure 13-6*, may be developed to fit the situation.



**Figure 13-5.** *Scanning pattern.*



**Figure 13-6.** *Night vision.*

## Obstruction Detection

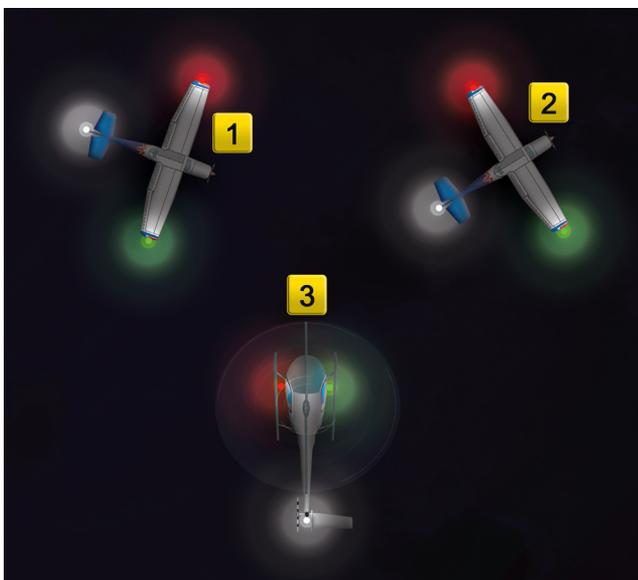
Obstructions having poor reflective surfaces, such as wires and small tree limbs, are difficult to detect. The best way to locate wires is by looking for the support structures. However, pilots should review the most current hazard maps with known wire locations before night flights.

## Aircraft Lighting

In order to see other aircraft more clearly, regulations require that all aircraft operating during the night hours have special lights and equipment. The requirements for operating at night are found in Title 14 of the Code of Federal Regulations (14 CFR) part 91. In addition to aircraft lighting, the regulations also provide a definition of night flight in accordance with 14 CFR part 91, currency requirements, fuel reserves, and necessary electrical systems.

Position lights enable a pilot to locate another aircraft, as well as help determine its direction of flight. The approved aircraft lights for night operations are a green light on the right cabin side or wingtip, a red light on the left cabin side or wingtip, and a white position light on the tail. In addition, flashing aviation red or white anticollision lights are required for night flights. These flashing lights can be in a number of locations, but are most commonly found on the top and bottom of the cabin.

*Figure 13-7* shows examples of aircraft lighting. By interpreting the position lights on other aircraft, the pilot in aircraft 3 can determine whether the aircraft is flying in the opposite direction or is on a collision course. If a red position light is seen to the right of a green light, such as shown by aircraft 1, it is flying toward aircraft 3. A pilot should watch this aircraft closely and be ready to change course. Aircraft 2,



**Figure 13-7.** Aircraft position lights.

on the other hand, is flying away from aircraft 3, as indicated by the white position light.

## Visual Illusions

Illusions give false impressions or misconceptions of actual conditions; therefore, pilots must understand the type of illusions that can occur and the resulting disorientation. Although the visual system is the most reliable of the senses, some illusions can result from misinterpreting what is seen; what is perceived is not always accurate. Even with the references outside the cockpit and the display of instruments inside, pilots must be on guard to interpret information correctly.

## Relative-Motion Illusion

Relative motion is the falsely perceived self-motion in relation to the motion of another object. The most common example is as follows. An individual in a car is stopped at a traffic light and another car pulls alongside. The individual that was stopped at the light perceives the forward motion of the second car as his or her own motion rearward. This results in the individual applying more pressure to the brakes unnecessarily. This illusion can be encountered during flight in situations such as formation flight, hover taxi, or hovering over water or tall grass.

## Confusion With Ground Lights

Confusion with ground lights occurs when a pilot mistakes ground lights for stars. The pilot can place the helicopter in an extremely dangerous flight attitude if he or she aligns it with the wrong lights. In *Figure 13-8A*, the helicopter is aligned with a road and not with the horizon. Isolated ground lights can appear as stars and could lead to the illusion that the helicopter is in a nose-high attitude.

When no stars are visible because of overcast conditions, unlighted areas of terrain can blend with the dark overcast to create the illusion that the unlighted terrain is part of the sky in *Figure 13-8B*. In this illusion, the shoreline is mistaken for the horizon. In an attempt to correct for the apparent nose-high attitude, a pilot may lower the collective and attempt to fly “beneath the shore.” This illusion can be avoided by referencing the flight instruments and establishing a true horizon and attitude.

## Reversible Perspective Illusion

At night, an aircraft or helicopter may appear to be moving away when it is actually approaching. If the pilot of each aircraft has the same assumption, and the rate of closure is significant, by the time each pilot realizes his or her own error in assumption, it may be too late to avoid a mishap. This illusion is called reversible perspective, and is often experienced when a pilot observes another aircraft or



**Figure 13-8.** At night, the horizon may be hard to discern due to dark terrain and misleading light patterns on the ground.

helicopter flying a parallel course. To determine the direction of flight, the pilot should observe the other aircraft's position lights. Remember the following: red on right returning; that is, if an aircraft is seen with the red position light on the right and the green position light on the left, the observed aircraft is traveling in the opposite direction.

### Flicker Vertigo

Flicker vertigo is technically not an illusion; however, as most people are aware from personal experience, viewing a flickering light can be both distracting and annoying. Flicker vertigo may be created by helicopter rotor blades or airplane propellers interrupting direct sunlight at a rate of 4 to 20 cycles per second. Flashing anticollision strobe lights, especially while the aircraft is in the clouds, can also produce this effect. One should also be aware that photic stimuli at certain frequencies could produce seizures in those rare individuals who are susceptible to flicker-induced epilepsy.

### Night Flight

The night flying environment and the techniques used when flying at night, depend on outside conditions. Flying on a bright, clear, moonlit evening when the visibility is good and the wind is calm is not much different from flying during the day. However, if flying on an overcast night over a sparsely populated area, with few or no outside lights on the ground, the situation is quite different. Visibility is restricted, so be more alert in steering clear of obstructions and low clouds. Options are also limited in the event of an emergency, as it is more difficult to find a place to land and determine wind direction and speed. At night, rely more heavily on the aircraft systems, such as lights, flight instruments, and navigation equipment. As a precaution, if visibility is limited or outside references are inadequate, strongly consider delaying the flight until conditions improve, unless proper instrument

flight training has been received and the helicopter has the appropriate instrumentation and equipment.

### Preflight

Aircraft preflight inspection is a critical aspect of flight safety. It must comply with the appropriate rotorcraft flight manual. Preflight should be scheduled as early as possible in the flight planning sequence, preferably during daylight hours, allowing time for maintenance assistance and correction. If a night preflight is necessary, a flashlight with an unfiltered lens (white light) should be used to supplement lighting. Oil and hydraulic fluid levels and leaks are difficult to detect with a blue-green or red lens. Windscreens are checked ensuring they are clean and relatively free of scratches. Slight scratches are acceptable for day flight but may not be for night flight. The search light or landing light should be positioned for the best possible illumination during an emergency descent.

Careful attention must be paid to the aircraft electrical system. In helicopters equipped with fuses, a spare set is required by regulation, and common sense, so make sure they are on board. If the helicopter is equipped with circuit breakers, check to see that they are not tripped. A tripped circuit breaker may be an indication of an equipment malfunction and should be left for maintenance to troubleshoot.

All aircraft operating between sunset and sunrise are required to have operable navigation (position) lights. Turn these lights on during the preflight to inspect them visually for proper operation. Between sunset and sunrise, these lights must be on any time the helicopter is operating.

All recently manufactured aircraft certificated for night flight must have an anticollision light that makes the aircraft more visible to other pilots. This light is either a red or white

flashing light and may be in the form of a rotating beacon or a strobe. While anticollision lights are required for night visual flight rules (VFR) flights, they may be turned off any time they create a distraction for the pilot.

One of the first steps in preparation for night flight is becoming thoroughly familiar with the helicopter's cockpit, instrumentation, and control layout. It is recommended that a pilot practice locating each instrument, control, and switch, both with and without cabin lights. Since the markings on some switches and circuit breaker panels may be difficult to read at night, be able to locate and use these devices, and read the markings in poor light conditions. Before starting the engine, make sure all necessary equipment and supplies needed for the flight, such as charts, notepads, and flashlights, are accessible and ready for use.

### **Cockpit Lights**

Check all interior lights with special attention to the instrument and panel lights. The panel lighting can usually be controlled with a rheostat or dimmer switch, allowing the pilot to adjust the intensity. If a particular light is too bright or causes reflection or glare off the windshield, it should be adjusted or turned off. As ambient level decreases from twilight to darkness, intensity of the cockpit lights is reduced to a low, usable intensity level that reduces any glare or reflection off the windshield. The light level should be adjusted to as close to the ambient light level as possible. A flashlight, with red or blue-green lens filter, or map light can supplement the available light in the cockpit. Always carry a flashlight with fresh batteries to provide an alternate source of light if the interior lights malfunction. If an existing map/utility light is used, it should be hand held or remounted to a convenient location. In order to retain night adaptation use low level light when using your checklist. Brief you passengers in the importance of light discipline during night flight so the pilot is not blinded and loses dark adaptation.

### **Engine Starting and Rotor Engagement**

Use extra caution when starting the engine and engaging the rotors, especially in dark areas with little or no outside lights. In addition to the usual call of "clear," turn on the position and anticollision lights. If conditions permit, also turn the landing light on momentarily to help warn others that the engine is about to start and engage the rotors.

### **Taxi Technique**

Landing lights usually cast a beam that is narrow and concentrated ahead of the helicopter, so illumination to the side is minimal. Therefore, slow the taxi at night, especially in congested ramp and parking areas. Some helicopters have a hover light in addition to a landing light, which illuminates a larger area under the helicopter.

When operating at an unfamiliar airport at night, ask for instructions or advice concerning local conditions, so as to avoid taxiing into areas of construction, or unlighted, unmarked obstructions. Ground controllers or UNICOM operators are usually cooperative in furnishing this type of information.

### **Takeoff**

Before takeoff, make sure that there is a clear, unobstructed takeoff path. At airports, this is accomplished by taking off over a runway or taxi way, however, if operating off-airport, pay more attention to the surroundings. Obstructions may also be difficult to see if taking off from an unlighted area. Once a suitable takeoff path is chosen, select a point down the takeoff path to use for directional reference. The landing light should be positioned in order to illuminate the tallest obstacles in the takeoff path. During a night takeoff, notice a lack of reliable outside visual references after becoming airborne. This is particularly true at small airports and off-airport landing sites located in sparsely populated areas. To compensate for the lack of outside references, use the available flight instruments as an aid. Check the altimeter and the airspeed indicator to verify the proper climb attitude. An attitude indicator, if installed, can enhance attitude reference.

The first 500 feet of altitude after takeoff is considered to be the most critical period in transitioning from the comparatively well-lit airport or heliport into what sometimes appears to be total darkness. A takeoff at night is usually an "altitude over airspeed" maneuver, meaning a pilot most likely performs a nearly maximum performance takeoff. This improves the chances for obstacle clearance and enhances safety.

### **En Route Procedures**

In order to provide a higher margin of safety, it is recommended that a cruising altitude somewhat higher than normal be selected. There are three reasons for this. First, a higher altitude gives more clearance between obstacles, especially those that are difficult to see at night, such as high tension wires and unlighted towers. Second, in the event of an engine failure, there is more time to set up for a landing and the greater gliding distance gives more options for a safe landing. Third, radio reception is improved, particularly if using radio aids for navigation.

During preflight planning, it is recommended that a route of flight that is within reach of an airport, or any safe landing site, be selected when possible. It is also recommended that pilots fly as close as possible to a populated or lighted area, such as a highway or town. Not only does this offer more options in the event of an emergency, but also makes navigation a lot easier. A course comprised of a series of

slight zigzags to stay close to suitable landing sites and well-lit areas, only adds a little more time and distance to an otherwise straight course.

In the event of a forced landing at night, use the same procedure recommended for day time emergency landings. If available, turn on the landing light during the final descent to help in avoiding obstacles along the approach path.

### **Collision Avoidance at Night**

Because the quantity and quality of outside visual references are greatly reduced, a pilot tends to focus on a single point or instrument, making him or her less aware of the other traffic around. Make a special effort to devote enough time to scan for traffic. As discussed previously in the chapter, effective scanning is accomplished with a series of short, regularly spaced eye movements that bring successive areas of the sky into the central visual field. Each movement should not exceed 10 degrees, and each area should be observed for at least 1 second to enable detection. If the pilot detects a dimly lit object in a certain direction, the pilot should not look directly at the object, but scan the area adjacent to it, called off-center viewing. This will decrease the chances of fixating on the light and allow focusing more on the objects (e.g., tower, aircraft, ground lights). Short stops of a few seconds in duration in each scan will help to detect the light and its movement. A pilot can determine another aircraft's direction of flight by interpreting the position and anticollision lights, as previously described. When scanning, pilots should also remember to move their heads, not just their eyes. Physical obstructions can cover a considerable amount of sky, and the area can easily be uncovered by a small head movement.

### **Approach and Landing**

Night approaches and landings do have some advantages over daytime approaches, as the air is generally smoother and the disruptive effects of turbulence and excessive crosswinds are often absent. However, there are a few special considerations and techniques that apply to approaches at night. For example, when landing at night, especially at an unfamiliar airport, make the approach to a lighted runway and then use the taxiways to avoid unlighted obstructions or equipment.

Carefully controlled studies have revealed that pilots have a tendency to make lower approaches at night than during the day. This is potentially dangerous as there is a greater chance of hitting an obstacle, such as an overhead wire or fence, that is difficult to see. It is good practice to make steeper approaches at night, increasing the probability of clearing obstacles. Monitor altitude and rate of descent using the altimeter.

Another pilot tendency during night flight is to focus too much on the landing area and not pay enough attention to airspeed. If too much airspeed is lost, a settling-with-power condition may result. Maintain the proper attitude during the approach, and ensure that you keep some forward airspeed and movement until close to the ground. Outside visual references for airspeed and rate of closure may not be available, especially when landing in an unlit area, so pay special attention to the airspeed indicator.

Although the landing light is a helpful aid when making night approaches, there is an inherent disadvantage. The portion of the landing area illuminated by the landing light seems higher than the dark area surrounding it. This effect can cause a pilot to terminate the approach at an altitude that is too high, which may result in a settling-with-power condition and a hard landing.

### **Illusions Leading to Landing Errors**

Various surface features and atmospheric conditions encountered in landing can create illusions of incorrect height above and distance from the runway threshold. Landing errors from these illusions can be prevented by anticipating them during approaches, conducting an aerial visual inspection of unfamiliar airports before landing, using electronic glideslope or VASI systems when available, and maintaining optimum proficiency in landing procedures.

#### ***Featureless Terrain Illusion***

An absence of ground features, as when landing over water, darkened areas, and terrain made featureless by snow, can create the illusion that the aircraft is at a higher altitude than it actually is. The pilot who does not recognize this illusion will fly a lower approach.

#### ***Atmospheric Illusions***

Rain on the windscreen can create the illusion of greater height, and atmospheric haze can create the illusion of being at a greater distance from the runway. The pilot who does not recognize these illusions flies a lower approach. Penetration of fog can create the illusion of pitching up. The pilot who does not recognize this illusion steepens the approach, often quite abruptly.

#### ***Ground Lighting Illusions***

Lights along a straight path, such as a road, and even lights on moving trains can be mistaken for runway and approach lights. Bright runway and approach lighting systems, especially where few lights illuminate the surrounding terrain, may create the illusion of less distance to the runway.

The pilot who does not recognize this illusion flies a higher approach. Conversely, the pilot overflying terrain which has few lights to provide height cues may make a lower than normal approach.

## Helicopter Night VFR Operations

While ceiling and visibility significantly affect safety in night VFR operations, lighting conditions also have a profound effect on safety. Even in conditions in which visibility and ceiling are determined to be visual meteorological conditions, the ability to discern unlit or low contrast objects and terrain at night may be compromised. The ability to discern these objects and terrain is referred to as the “seeing condition,” and is related to the amount of natural and manmade lighting available, and the contrast, reflectivity, and texture of surface terrain and obstruction features. In order to conduct operations safely, seeing conditions must be accounted for in the planning and execution of night VFR operations.

Night VFR seeing conditions can be described by identifying high lighting conditions and low lighting conditions.

High lighting conditions exist when one of two sets of conditions are present:

1. The sky cover is less than broken (less than  $\frac{5}{8}$  cloud cover), the time is between the local moon rise and moon set, and the lunar disk is at least 50 percent illuminated; or
2. The aircraft is operated over surface lighting that, at least, provides lighting of prominent obstacles, the identification of terrain features (shorelines, valleys, hills, mountains, slopes) and a horizontal reference by which the pilot may control the helicopter. For example, this surface lighting may be the result of:
  - a. Extensive cultural lighting (manmade, such as a built-up area of a city),
  - b. Significant reflected cultural lighting (such as the illumination caused by the reflection of a major metropolitan area’s lighting reflecting off a cloud ceiling), or
  - c. Limited cultural lighting combined with a high level of natural reflectivity of celestial illumination, such as that provided by a surface covered by snow or a desert surface.

Low lighting conditions are those that do not meet the high lighting conditions requirements.

Some areas may be considered a high lighting environment only in specific circumstances. For example, some surfaces, such as a forest with limited cultural lighting, normally have little reflectivity, requiring dependence on significant moonlight to achieve a high lighting condition. However, when that same forest is covered with snow, its reflectivity may support a high lighting condition based only on starlight. Similarly, a desolate area, with little cultural lighting, such as a desert, may have such inherent natural reflectivity that it may be considered a high lighting conditions area regardless of season, provided the cloud cover does not prevent starlight from being reflected from the surface. Other surfaces, such as areas of open water, may never have enough reflectivity or cultural lighting to ever be characterized as a high lighting area.

Through the accumulation of night flying experience in a particular area, the pilot develops the ability to determine, prior to departure, which areas can be considered supporting high or low lighting conditions. Without that pilot experience, low lighting considerations should be applied by pilots for both preflight planning and operations until high lighting conditions are observed or determined to be regularly available.

## Chapter Summary

Knowledge of the basic anatomy and physiology of the eye is helpful in the study of helicopter night operations. Adding to that knowledge a study of visual illusions gives the pilot ways to overcome those illusions. Techniques for preflight, engine start-up, collision avoidance, and night approach and landings help teach the pilot safer ways to conduct flight at night. More detailed information on the subjects discussed in this chapter is available in the Aeronautical Information Manual (AIM) and online at [www.faa.gov](http://www.faa.gov).