Chapter 12

Night Operations

Introduction

It must be understood that flying at night presents a number of new challenges for the pilot and additional equipment for the aircraft. Flying at night in a weight-shift control (WSC) aircraft should be done only with some visual reference to the ground such as city lights or a full moon. Flying with no consistent visual reference to the surface results in disorientation, a likely loss of control, and an accident. New WSC aircraft can be fitted with instruments similar to those in airplanes in order to fly at night without visual reference to the horizon, but this is not recommended. However, flying with instruments is covered in this chapter.

Pilot Requirements

Flying at night requires additional pilot skills and a private pilot certificate. It is possible to have a private pilot certificate with a "Night Flight Prohibited" limitation if the pilot did not complete night flight training and is restricted from night flight, similar to that for Sport Pilots. This is an option for pilots who want a private pilot certificate but do not plan to fly at night. If the pilot first obtains the private certificate with the night limitation, the limitation can be removed after completing the private pilot WSC night training. The training that must be accomplished at night for WSC private pilot night flying privileges is:

1. One cross-country flight over 75 nautical miles (NM) total distance, and
2. Ten takeoffs and landings (each landing involving a flight in the traffic pattern) at an airport.

Sport pilots or private pilots with the night limitation are not allowed to fly at night; however, they can fly after sunset during civil twilight until night if the aircraft is properly equipped with position lights. Civil twilight is when the sun is less than 6° below the horizon, about 30 minutes before sunrise or after sunset, and varies by latitude throughout the year. It is the time when there is enough light outdoors for activities to be conducted without additional lighting. *[Figure 12-1]* If it is overcast and visibility is inadequate, good pilot judgment would dictate not to fly after sunset.

Equipment and Lighting

Title 14 of the Code of Federal Regulations (14 CFR) part 91 specifies the minimum aircraft equipment required for flight during civil twilight and night flight. This equipment includes only position lights. Normal standard category aircraft are required to have this additional equipment as would also be recommended for WSC night flight, including anti-collision light, landing lights, adequate electrical source for lights, and spare fuses. The standard instruments required for instrument flight under 14 CFR part 91 are a valuable asset for aircraft control at night but are not required.

Aircraft position lights are required on all aircraft from sunset to sunrise in an arrangement similar to those on boats and ships. A red light is positioned on the left wing tip, a green light on the right wing tip, and a white light on the tail. *[Figures 12-2* and *12-3]* This arrangement allows the pilot to determine the general direction of movement of other aircraft in flight. If both position lights of another aircraft are observed, a red light on the right and a green light on the left, the aircraft is flying toward the pilot and could be on a collision course. Similarly, a green light on the right and a red light on the left indicate the aircraft is flying in the same direction as the pilot observing the lights. Landing lights are not only useful for taxi, takeoffs, and landings, but also provide an additional means by which aircraft can be seen at night by other pilots. *[Figure 12-4]*

The Federal Aviation Administration (FAA) has initiated a voluntary pilot safety program called "Operation Lights On." The "lights on" idea is to enhance the "see and be seen" concept of averting collisions in the air and on the ground and to reduce the potential for bird strikes. Pilots are encouraged to turn on their landing lights when operating within 10 miles of an airport. This is for both day and night or in conditions of reduced visibility. This should also be done in areas where flocks of birds may be expected.

Although turning on aircraft lights supports the "see and be seen" concept, pilots should not become complacent about keeping a sharp lookout for other aircraft. Most aircraft lights blend in with stars or city lights at night and go unnoticed

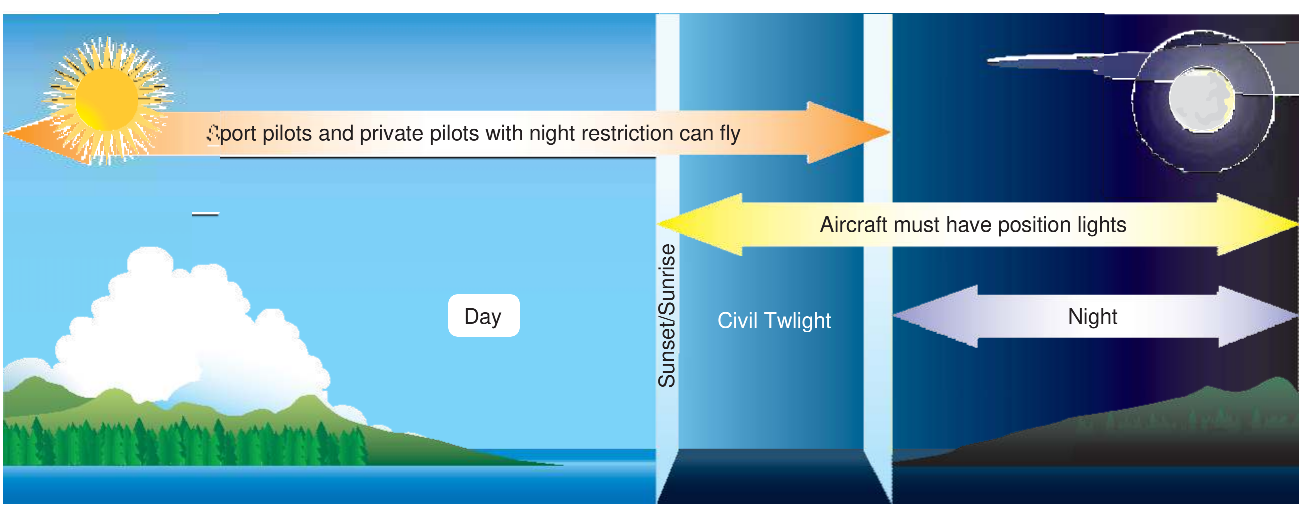

Figure 12-1. *Day, twilight, and night time.*

Figure 12-2. *Position lights.*

unless a conscious effort is made to distinguish them from other lights.

Pilot Equipment

Before beginning a night flight, carefully consider personal equipment that should be readily available during the flight.

Figure 12-3. *Modern LED position lights on carriage wheel pants simplify the installation with no wires running from the carriage to the wing tips.*

At least one reliable flashlight is recommended as standard equipment on all night flights. Remember to place a spare set of batteries in the flight kit. A spare flashlight is the better choice, eliminating the need to change batteries during flight.

Figure 12-4. *Landing light on WSC aircraft taxiing at night.*

A D-cell size flashlight with a bulb switching mechanism that can be used for white or red light is preferable. The white light is used while performing the preflight visual inspection on the ground, and the red light is used when performing flight deck operations. Since the red light is nonglaring, it does not impair night vision. Some pilots prefer two flashlights, one with a white light for preflight and the other a penlight with a red light. The latter can be suspended by a string around the neck to ensure the light is always readily available. Be aware that if a red light is used for reading an aeronautical chart, the red features of the chart will not show up.

Aeronautical charts are essential for night cross-country flight and, if the intended course is near the edge of the chart, the adjacent chart should also be available. The lights of cities and towns can be seen at surprising distances at night, and if this adjacent chart is not available to identify those landmarks, confusion could result. Regardless of the equipment used, organization of the flight deck eases the burden on the pilot and enhances safety. *[Figure 12-5]*

Airport and Navigation Lighting Aids

The lighting systems used for airports, runways, obstructions, and other visual aids at night are other important aspects of night flying.

Lighted airports located away from congested areas can be identified readily at night by the lights outlining the runways. Airports located near or within large cities are often difficult to identify in the maze of lights. It is important to know the exact location of an airport relative to the city, and also be able to identify these airports by the characteristics of their lighting pattern.

Aeronautical lights are designed and installed in a variety of colors and configurations, each having its own purpose. Although some lights are used only during low ceiling and visibility conditions, this discussion includes only the lights that are fundamental to visual flight rules (VFR) night operation.

It is recommended that prior to a night flight, and particularly a cross-country night flight, the pilot check the availability and status of lighting systems at the destination airport. This information can be found on aeronautical charts and in the Airport/Facility Directory (A/FD). The status of each facility can be determined by reviewing pertinent Notices to Airmen (NOTAMs).

A rotating beacon is used to indicate the location of most airports. The beacon rotates at a constant speed, thus

Figure 12-5. *WSC aircraft equipped for night cross-country flight with flashlight and aeronautical charts on kneeboards.*

producing what appears to be a series of light flashes at regular intervals. These flashes may be one or two different colors that are used to identify various types of landing areas. For example:

- Lighted civilian land airports—alternating white and green
- Lighted civilian water airports—alternating white and yellow
- Lighted military airports—alternating white and green, but are differentiated from civil airports by dual peaked (two quick) white flashes, then green

Beacons producing red flashes indicate obstructions or areas considered hazardous to aerial navigation. Steady burning red lights are used to mark obstructions on or near airports and sometimes to supplement flashing lights on en route obstructions. High intensity flashing white lights are used to mark some supporting structures of overhead transmission lines that stretch across rivers, chasms, and gorges. These high intensity lights are also used to identify tall structures, such as chimneys and towers.

As a result of technological advancements in aviation, runway lighting systems have become quite sophisticated to accommodate takeoffs and landings in various weather conditions. However, the pilot whose flying is limited to VFR needs to be concerned only with the following basic lighting of runways and taxiways.

The basic runway lighting system consists of two straight parallel lines of runway-edge lights defining the lateral limits of the runway. These lights are aviation white, although aviation yellow may be substituted for a distance of 2,000 feet from the far end of the runway to indicate a caution zone. At some airports, the intensity of the runway-edge lights can be adjusted to satisfy the individual needs of the pilot. The length limits of the runway are defined by straight lines of lights across the runway ends. At some airports, the runway threshold lights are aviation green, and the runway end lights are aviation red.

At many airports, the taxiways are also lighted. A taxiway-edge lighting system consists of blue lights that outline the usable limits of taxi paths. See the Pilot's Handbook of Aeronautical Knowledge for additional information on airport lighting.

Night Vision

Generally, most pilots are poorly informed about night vision. Human eyes never function as effectively at night as the eyes of nocturnal animals, but if humans learn how to use their eyes correctly and know their limitations, night vision can be improved significantly. The human eye is constructed so that day vision is different from night vision. Therefore, it is important to understand the eye's construction and how the eye is affected by darkness.

Innumerable light-sensitive nerves called cones and rods are located at the back of the eye or retina, a layer upon which all images are focused. These nerves connect to the cells of the optic nerve, which transmits messages directly to the brain. The cones are located in the center of the retina, and the rods are concentrated in a ring around the cones. *[Figure 12-6]*

The function of the cones is to detect color, details, and faraway objects. The rods function when something is seen out of the corner of the eye or peripheral vision. They detect objects, particularly those that are moving, but do not give detail or color—only shades of gray. Both the cones and the rods are used for vision during daylight.

Although there is not a clear-cut division of function, the rods make night vision possible. The rods and cones function in daylight and in moonlight; in the absence of normal light, the process of night vision is almost entirely a function of the rods.

The fact that the rods are distributed in a band around the cones and do not lie directly behind the pupils makes off-center viewing (looking to one side of an object) important during night flight. During daylight, an object can be seen best by looking directly at it, but at night a scanning procedure to permit off-center viewing of the object is more effective. Therefore, the pilot should consciously practice this scanning procedure to improve night vision.

The eye's adaptation to darkness is another important aspect of night vision. When a dark room is entered, it is difficult to see anything until the eyes become adjusted to the darkness. In the adaptation process, the pupils of the eyes first enlarge to receive as much of the available light as possible. After approximately 5 to 10 minutes, the cones become adjusted to the dim light and the eyes become 100 times more sensitive to light than they were before the dark room was entered. About 30 minutes is needed for the rods to become adjusted to darkness; when they do adjust, they are about 100,000 times more sensitive to light than in the lighted area. After the adaptation process is complete, much more can be seen, especially if the eyes are used correctly.

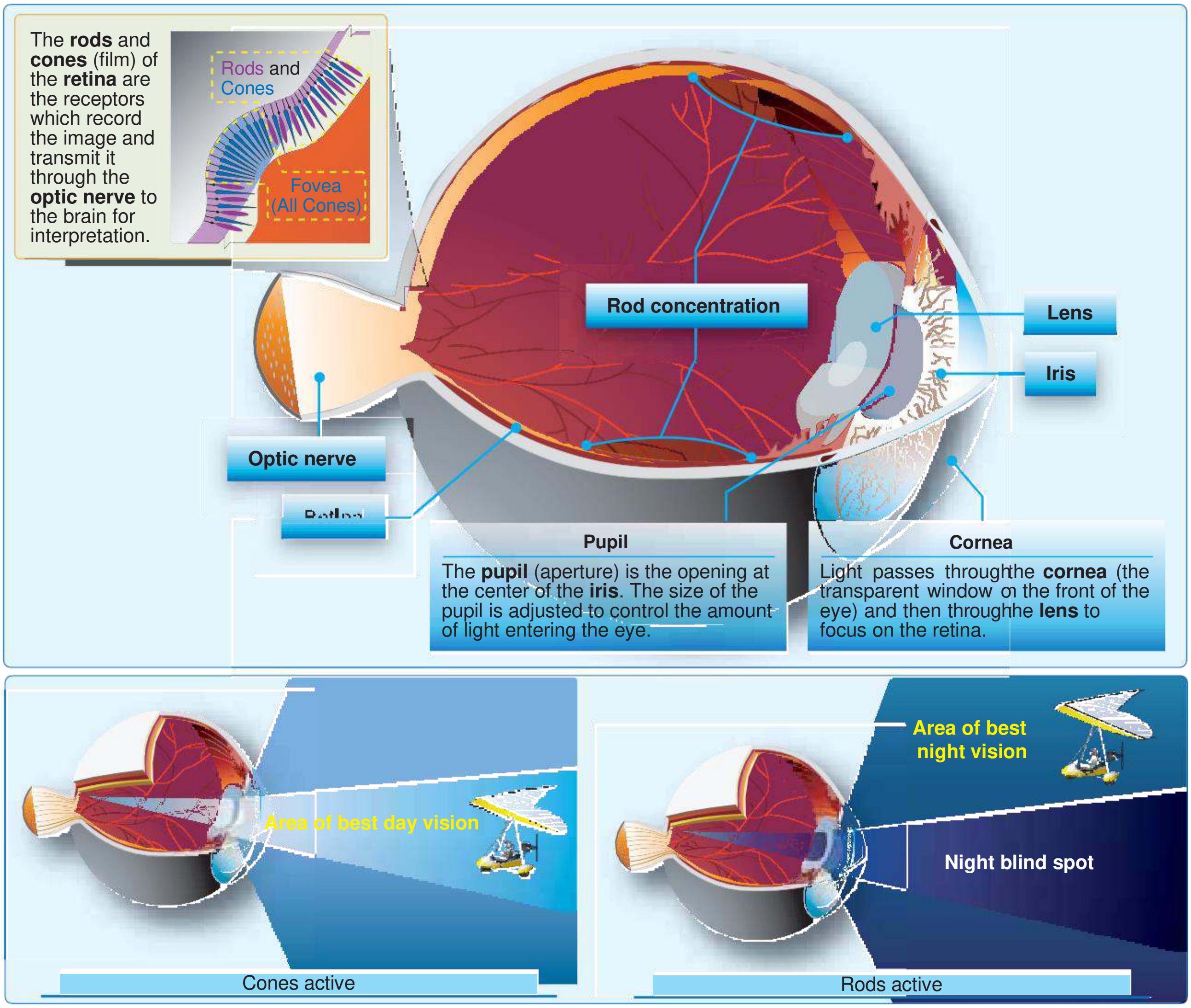

Figure 12-6. *Rods and cones.*

After the eyes have adapted to the dark, the entire process is reversed when entering a lighted room. The eyes are first dazzled by the brightness, but become completely adjusted in a few seconds, thereby losing their adaptation to the dark. Now, if the dark room is reentered, the eyes again go through the long process of adapting to the darkness.

Before and during night flight, the pilot must consider the adaptation process of the eyes. First, the eyes should be allowed to adapt to the low level of light. Then, the pilot should avoid exposing them to any bright white light that would cause temporary blindness and possibly result in serious consequences.

Temporary blindness, caused by an unusually bright light, may result in illusions or afterimages until the eyes recover from the brightness. The brain creates these illusions reported by the eyes. This results in misjudging or incorrectly identifying objects, such as mistaking slanted clouds for the horizon or a populated area for a landing field. Vertigo is experienced as a feeling of dizziness and imbalance that can create or increase illusions. The illusions seem very real and pilots at every level of experience and skill can be affected. Recognizing that the brain and eyes can play tricks in this manner is the best protection for flying at night.

Good eyesight depends upon physical condition. Fatigue, colds, vitamin deficiency, alcohol, stimulants, smoking, or medication can seriously impair vision. Keeping these facts in mind and taking appropriate precautions should help safeguard night vision.

In addition to the principles previously discussed, the following actions aid in increasing night vision effectiveness:

- Adapt the eyes to darkness prior to flight, and keep them adapted. About 30 minutes is needed to adjust the eyes to maximum efficiency after exposure to a bright light.
- Use oxygen during night flying, if available. Keep in mind that a significant deterioration in night vision can occur at altitudes as low as 5,000 feet.
- Close one eye when exposed to bright light to help avoid the blinding effect.
- Avoid wearing sunglasses after sunset.
- Move the eyes more slowly than in daylight.
- Blink the eyes if vision becomes blurred.
- Concentrate on seeing objects.
- Force the eyes to view off center.
- Maintain good physical condition.
- Avoid smoking, drinking, and using drugs that may be harmful.

Unique WSC Flight Characteristics

If the WSC aircraft is trimmed properly and the pilot is proficient in the basic flight maneuvers of climbs, cruise, and descent procedures, the WSC aircraft speed is easily determined with control bar pressure and position for normal flight conditions. A pilot can also determine basic climbs and descents through the feel of the aircraft with the airspeed and throttle positions. Therefore, basic pitch control can be done by a proficient pilot with his or her eyes closed.

As discussed in Chapter 2, Aerodynamics, WSC aircraft are generally not designed to be roll stable, and any engine turning effect or movement of the air can put the WSC aircraft into a roll, which it maintains unless corrected by the pilot. In other words, releasing the control bar in a WSC aircraft will not level a bank back to straight flight. The pilot must continually provide input to fly a constant heading even if this control is small corrections. In other words, the pilot cannot level the wings or fly a straight heading for very long with his or her eyes closed.

To maintain a constant heading or ground track, one of three instruments can be used: magnetic compass, global positioning system (GPS), and aircraft heading indicator. Without a visual reference, these can be used to fly straight. An attitude indicator can be used on WSC aircraft providing additional instrument reference. These instruments and others are discussed later in this chapter.

Night Illusions

In addition to night vision limitations, pilots should be aware that night illusions could cause confusion and concerns during night flying. The following discussion covers some of the common situations that cause illusions associated with night flying.

A false horizon can occur when the natural horizon is obscured or not readily apparent. It can be generated by confusing bright stars and city lights. It can also occur while flying toward the shore of an ocean or a large lake. Because of the relative darkness of the water, the lights along the shoreline can be mistaken for stars in the sky. *[Figure 12-7]*

Figure 12-7. *At night, the horizon may be hard to discern due to dark terrain and misleading light patterns on the ground.*

On a clear night, distant stationary lights can be mistaken for stars or other aircraft. Even the northern lights can confuse a pilot and indicate a false horizon. Certain geometrical patterns of ground lights, such as a freeway, runway, approach, or even lights on a moving train can cause confusion. Dark nights tend to eliminate reference to a visual horizon. As a result, pilots need to rely less on outside references at night and more on flight and navigation instruments.

Visual autokinesis can occur when a pilot stares at a single light source for several seconds on a dark night. The result is that the light appears to be moving. The autokinesis effect does not occur if the pilot expands the visual field. It is a good procedure to vary visual focus and not become fixed on one source of light.

Distractions and problems can result from a flickering light in the flight deck, such as anticollision lights, strobe lights, or other aircraft lights which can cause flicker vertigo. If continuous, the possible physical reactions can be nausea, dizziness, grogginess, confusion, headaches, or unconsciousness. The pilot should try to eliminate any light source causing blinking or flickering problems in the flight deck.

A black-hole approach occurs when the landing is made from over water or unlighted terrain on which runway lights are the only sources of light. Without peripheral visual cues to help, pilots have trouble orienting themselves relative to Earth. The runway can seem out of position (downsloping or upsloping) and, in the worst case, result in landing short of the runway. If an electronic glideslope or visual approach slope indicator (VASI) is available, it should be used. If navigation aids (NAVAIDs) are unavailable, careful attention should be given to using the flight instruments to assist in maintaining orientation and a normal approach. If at any time the pilot is unsure of his or her position or attitude, a go-around should be executed.

Bright runway and approach lighting systems, especially where few lights illuminate the surrounding terrain, may create the illusion of less distance to the runway. In this situation, the tendency is to fly a higher approach. Also, when flying over terrain with only a few lights, it makes the runway recede or appear farther away. With this situation, the tendency is common to fly a lower-than-normal approach. If the runway has a city in the distance on higher terrain, the tendency is to fly a lower-than-normal approach. A good review of the airfield layout and boundaries before initiating any approach helps the pilot maintain a safe approach angle.

Illusions created by runway lights result in a variety of problems. Bright lights or bold colors advance the runway, making it appear closer. Night landings are further complicated by the difficulty of judging distance and the possibility of confusing approach and runway lights. For example, when a double row of approach lights joins the boundary lights of the runway, there can be confusion where the approach lights terminate and runway lights begin. Under certain conditions, approach lights can make the aircraft seem higher in a turn to final than when its wings are level.

Preparation and Preflight

Night flying requires that pilots be aware of and operate within their abilities and limitations. Although careful planning of any flight is essential, night flying demands more attention to the details of preflight preparation and planning.

Preparation for a night flight should include a thorough review of the available weather reports and forecasts with particular attention given to temperature-dew point spread. A narrow temperature-dew point spread may indicate the possibility of ground fog. Emphasis should also be placed on wind direction and speed, since wind effects on the aircraft cannot be as easily detected at night as during the day.

On night cross-country flights, appropriate aeronautical charts should be selected, including the appropriate adjacent charts. Course lines should be drawn in black to be more distinguishable.

Prominently lighted checkpoints along the prepared course should be noted. Rotating beacons at airports, lighted obstructions, lights of cities or towns, and lights from major highway traffic all provide excellent visual checkpoints. The use of a GPS with a lighted screen adds significantly to the safety and efficiency of night flying.

All personal equipment should be checked prior to flight to ensure proper functioning. It is very disconcerting to find at the time of need that a flashlight does not work.

All aircraft lights should be turned on momentarily and checked for operation. Position lights can be checked for loose connections by tapping the light fixture. If the lights blink while being tapped, further investigation to determine the cause should be made prior to flight.

The parking ramp should be examined prior to entering the aircraft. During the day, it is quite easy to see stepladders, chuckholes, wheel chocks, and other obstructions, but at night it is more difficult. A check of the area can prevent taxiing mishaps.

Starting, Taxiing, and Runup

After the pilot is seated in the flight deck and prior to starting the engine, all items and materials to be used on the flight should be arranged in such a manner that they will be readily available and convenient to use.

Extra caution should be taken at night to assure the propeller area is clear. Turning the rotating beacon on or flashing the aircraft position lights serves to alert persons nearby to remain clear of the propeller. To avoid excessive drain of electrical current from the battery, it is recommended that unnecessary electrical equipment be turned off until after the engine has been started.

After starting and before taxiing, the taxi or landing light should be turned on. Continuous use of the landing light with revolutions per minute (rpm) power settings normally used for taxiing may place an excessive drain on the aircraft's electrical system. Also, overheating of the landing light could become a problem because of inadequate airflow to carry the heat away. Landing lights should be used as necessary while taxiing. When using landing lights, consideration should be given to not blinding other pilots. Taxi slowly, particularly in congested areas. If taxi lines are painted on the ramp or taxiway, these lines should be followed to ensure a proper path along the route.

The before takeoff and runup should be performed using the checklist. During the day, forward movement of the aircraft can be detected easily. At night, the aircraft could creep forward without being noticed unless the pilot is alert for this possibility. Hold or lock the brakes during the runup and be alert for any forward movement. *[Figure 12-8]*

Figure 12-8. *Reviewing before-takeoff checklist, which is included for the flight with the sectional charts on the kneeboard.*

Takeoff and Climb

Night flying is very different from day flying and demands more attention of the pilot. The most noticeable difference is the limited availability of outside visual references. Therefore, flight instruments should be used as a reference in controlling the aircraft. This is particularly true on night takeoffs and climbs. The flight deck lights should be adjusted to a minimum brightness that allows the pilot to read the instruments and switches but not hinder the pilot's outside vision. This also eliminates light reflections on the windshield and instruments.

After ensuring that the final approach and runway are clear of other air traffic, or when cleared for takeoff by the tower, the landing lights and taxi lights should be turned on and the WSC aircraft lined up with the centerline of the runway. If the runway does not have centerline lighting, use the painted centerline and the runway edge lights. After the aircraft is aligned, the heading indicator should be noted or set to correspond to the known runway direction. The magnetic compass should read the exact direction of the runway. The GPS does not provide meaningful information while stopped or turning because it measures ground track and needs to be moving to register enough points to provide accurate data.

To begin the takeoff, the brakes should be released and the throttle smoothly advanced to maximum allowable power. As the aircraft accelerates, it should be kept moving straight ahead between and parallel to the runway-edge lights.

The procedure for night takeoffs is the same as for normal daytime takeoffs except that many of the runway visual cues are not available. Therefore, the airspeed flight instrument can be checked during the takeoff roll to ensure the proper airspeed in being obtained. As the airspeed reaches the normal lift-off speed, the pitch attitude should be adjusted to that which establishes a normal climb. This should be accomplished by using the normal control bar position for the desired climb speed. After liftoff, instruments can be checked for proper heading, and airspeed. *[Figures 12-9* and *12-10]*

The darkness of night often makes it difficult to note whether the airborne aircraft is getting closer to or farther from the surface. To ensure the aircraft continues in a positive climb, be sure a climb is indicated on the attitude indicator (if equipped), vertical speed indicator (VSI), and altimeter. It is also important to ensure the airspeed is at best climb speed.

Necessary pitch and bank adjustments should be made by referencing the attitude, heading, or ground track indicators. Heading indicators include both the aircraft heading indicators and the magnetic compass. Once the aircraft starts moving and establishing a ground track straight down the runway, the GPS has data points to establish a ground track and becomes useful once in flight. It is recommended that turns not be made until reaching a safe maneuvering altitude.

Although the use of the landing lights provides help during the takeoff, they become ineffective soon after liftoff when

Figure 12-9. *Classic instrument gauges for WSC aircraft.*

Figure 12-10. *Digital panel instrument gauges for WSC aircraft.*

the aircraft has climbed to an altitude at which the light beam no longer extends to the surface. The light can cause distortion when it is reflected by haze, smoke, or fog that might exist in the climb. Therefore, when the landing light is used for the takeoff, it may be turned off after the climb is well established provided other traffic in the area does not require its use for collision avoidance.

A properly lit instrument panel and visual reference to the ground with city lights are recommended for night flying. *[Figure 12-11]*

Orientation and Navigation

At night, it is usually difficult to see clouds and restrictions to visibility, particularly on dark nights or under overcast. The pilot flying under VFR must exercise caution to avoid flying into clouds or a layer of fog. Usually, the first indication of flying into restricted visibility conditions is the gradual disappearance of lights on the ground. If the lights begin to take on an appearance of being surrounded by a halo or glow, the pilot should use caution in attempting further flight in that same direction. Such a halo or glow around lights on the ground is indicative of ground fog. Remember that if a descent to land must be made through fog, smoke, or haze, the horizontal visibility is considerably less. Under no circumstances should a night flight be made during poor or marginal weather conditions.

The pilot should practice and acquire competency in straight-and-level flight, climbs and descents, level turns, climbing and descending turns, and steep turns. The pilot should also practice these maneuvers with all the flight deck lights turned off. This blackout training is necessary if the pilot experiences an electrical or instrument light failure. Training should also include using the navigation equipment and local NAVAIDs.

In spite of fewer references or checkpoints, night cross-country flights do not present particular problems if preplanning is adequate, and the pilot continues to monitor position, time estimates, and fuel consumption. The GPS is the most valuable instrument for day and night cross-country flying. For night cross-country flying, spare batteries or a GPS hooked to the aircraft electric system with a battery backup is recommended. NAVAIDs,

Figure 12-11. *A properly lit instrument panel and city lights provide recommended conditions for night flying.*

if available, should also be used to assist in monitoring en route progress.

Crossing large bodies of water at night in single-engine aircraft is hazardous and not recommended by day or night. This is from the standpoint of landing (ditching) in the water, but especially at night because with little or no lighting the horizon blends with the water making depth perception and orientation difficult. During poor visibility conditions over water, the horizon becomes obscure and may result in a loss of orientation. Even on clear nights, the stars may be reflected on the water surface which could appear as a continuous array of lights making the horizon difficult to identify.

Lighted runways, buildings, or other objects may cause illusions when seen from different altitudes. At an altitude of 2,000 feet, a group of lights on an object may be seen individually; while at 5,000 feet or higher, the same lights could appear to be one solid light mass. These illusions may become quite acute with altitude changes and, if not overcome, could present problems in respect to approaches to lighted runways.

Approaches and Landings

When approaching the airport to enter the traffic pattern and land, it is important that the runway lights and other airport lighting be identified as early as possible. If the airport layout is unfamiliar to the pilot, sighting of the runway may be difficult until very close-in due to the maze of lights observed in the area. *[Figure 12-12]* The pilot should fly toward the rotating beacon until the lights outlining the runway are distinguishable. To fly a traffic pattern of proper size and direction, the runway threshold and runway-edge lights must be positively identified. Once the airport lights are seen, these lights should be kept in sight throughout the approach.

Distance may be deceptive at night due to limited lighting conditions. A lack of intervening references on the ground and the inability of the pilot to compare the size and location of different ground objects cause this. This also applies to the estimation of altitude and speed. Consequently, more dependence must be placed on flight instruments, particularly the altimeter and the airspeed indicator.

When entering the traffic pattern, allow for plenty of time to complete the before landing checklist. If the heading indicator contains a heading bug, setting it to the runway heading is an excellent reference for the pattern legs.

Every effort should be made to maintain the recommended airspeeds and execute the approach and landing in the same manner as during the day. A low, shallow approach is definitely inappropriate during a night operation. The altimeter and VSI should be constantly cross-checked against the aircraft's position along the base leg and final approach. A visual approach slope indicator (VASI) is an indispensable aid in alerting a pilot of too low of a glidepath. The typical VASI is set to 3° for the recommended aircraft approach. This 19 to 1 glide ratio is too low for a WSC aircraft. A normal glide ratio for WSC aircraft is 5 to 1, which is 11°, much higher than the normal 3° to 4° used by aircraft. Therefore, for WSC VASI final approaches both white lights should be visible. If a pilot sees red over white, or especially both reds, the approach is too low and altitude should be gained, or at least maintained to get above the normal VASI 3° to 4° approach at night. This steeper approach allows the WSC aircraft to glide to the runway and land safely in the event of engine failure. *[Figure 12-13]*

Figure 12-12. *Use light patterns for orientation.*

After turning onto the final approach and aligning the aircraft midway between the two rows of runway-edge lights, the pilot should note and correct for any wind drift. Throughout the final approach, pitch and power should be used to maintain a stabilized approach. Usually, halfway through the final approach, the landing light should be turned on. Earlier use of the landing light may be necessary because of "Operation Lights On" or for local traffic considerations. The landing light is sometimes ineffective since the light beam usually does not reach the ground from higher altitudes. The light may even be reflected back into the pilot's eyes by any existing haze, smoke, or fog. This disadvantage is overshadowed by the safety considerations provided by using the "Operation Lights On" procedure around other traffic.

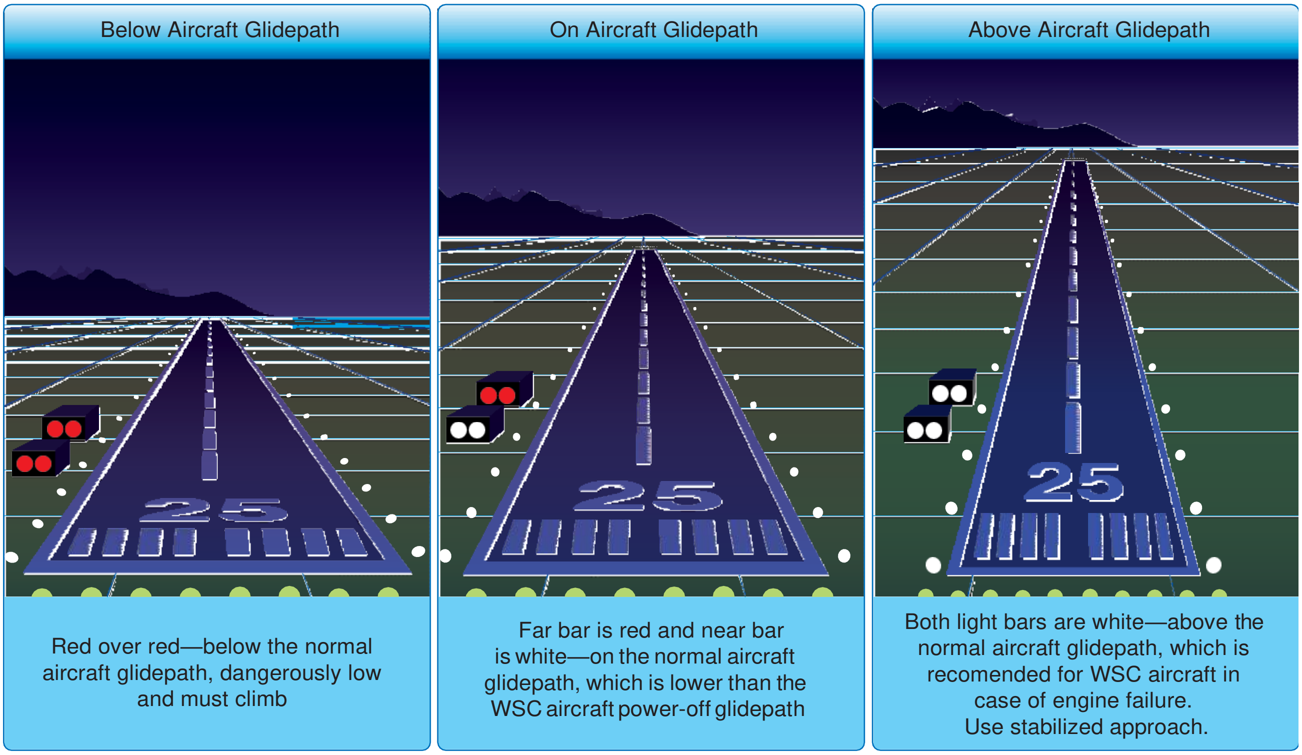

Figure 12-13. *VASI.*

The approach and landings should be made in the same manner as in day landings as discussed in Chapter 11, Approaches and Landings. At night, the judgment of height, speed, and sink rate is impaired by the scarcity of observable objects in the landing area. The inexperienced pilot may have a tendency to round out too high until attaining familiarity with the proper height for the correct roundout. To aid in night landings, approach with power on to reduce the descent rate providing more time for the pilot to see the runway and start the roundout once the runway is visible. To aid in determining the proper roundout point, continue a constant approach descent until the landing lights reflect on the runway and tire marks on the runway can be clearly seen. At this point, the roundout should be started smoothly and the throttle gradually reduced to idle as the aircraft is touching down. *[Figure 12-14]* During landings without the use of landing lights, the roundout may be started when the runway lights at the far end of the runway first appear to be rising higher than the nose of the aircraft. This demands a smooth and very timely roundout, and requires that the pilot feel for the runway surface using power and pitch changes, as necessary, for the aircraft to settle slowly to the runway. Blackout landings should always be included in night pilot training as an emergency procedure.

Night Emergencies

Perhaps the pilot's greatest concern about flying a single-engine aircraft at night is the possibility of a complete engine failure and the subsequent emergency landing. This is a legitimate concern, even though continuing flight into adverse weather and poor pilot judgment account for most serious accidents.

If the engine fails at night, several important procedures and considerations to keep in mind are:

- Maintain positive control of the aircraft and establish the best glide configuration and airspeed. Turn the aircraft toward an airport or away from congested areas.
- Check to determine the cause of the engine malfunction, such as the position of fuel shutoff, magneto switch, or primer. If possible, the cause of the malfunction should be corrected immediately and the engine restarted.
- Announce the emergency situation to Air Traffic Control (ATC) or UNICOM. If already in radio contact with a facility, do not change frequencies unless instructed to change.

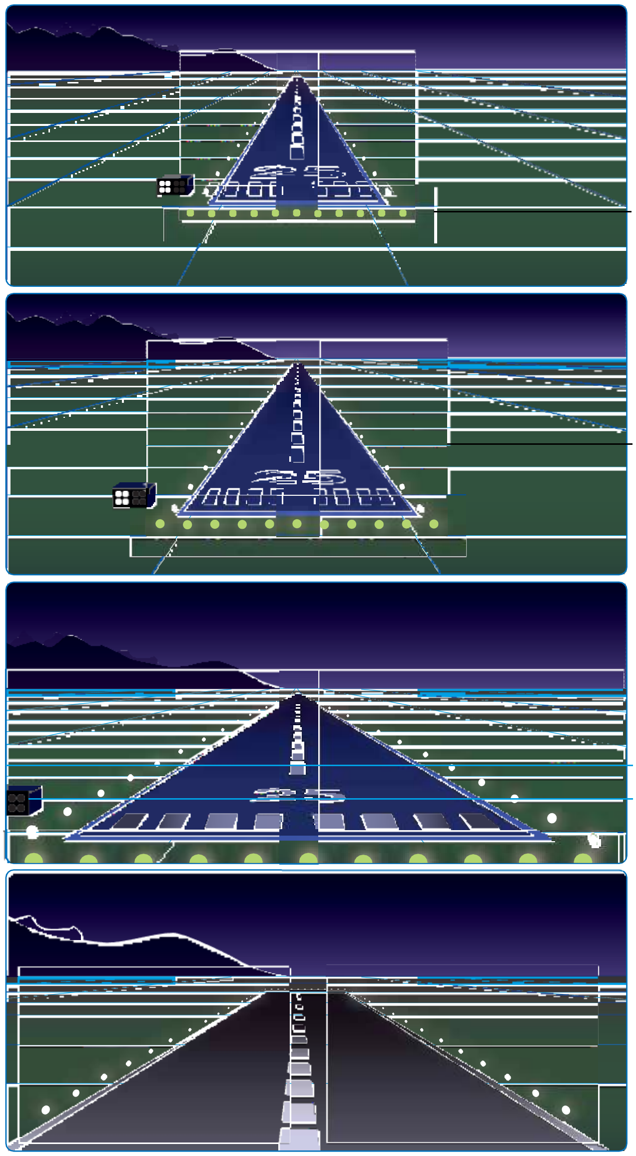

Figure 12-14. *Roundout when tire marks are visible.*

- Consider an emergency landing area close to public access if possible. This may facilitate rescue or help, if needed.
- Maintain orientation with the wind to avoid a downwind landing.
- Complete the before landing checklist, and check the landing lights for operation at altitude and turn on in sufficient time to illuminate the terrain or obstacles along the flightpath. The landing should be completed in the normal landing attitude at the slowest possible airspeed. If the landing lights are unusable and outside visual references are not available, the aircraft should be held minimum controlled airspeed until the ground is contacted.
- After landing, turn off all switches and evacuate the aircraft as quickly as possible.

Chapter Summary

Night flight requires additional training, a private pilot certificate, and should be performed only when there is adequate reference with the Earth, such as city lights or a full moon. Night flight should never be performed over open water.

Night illusions require reference to flight instruments. WSC pilots can determine pitch control by feel but cannot determine roll and heading by feel so instrumentation such as a heading indicator, magnetic compass, or GPS is needed for directional reference.