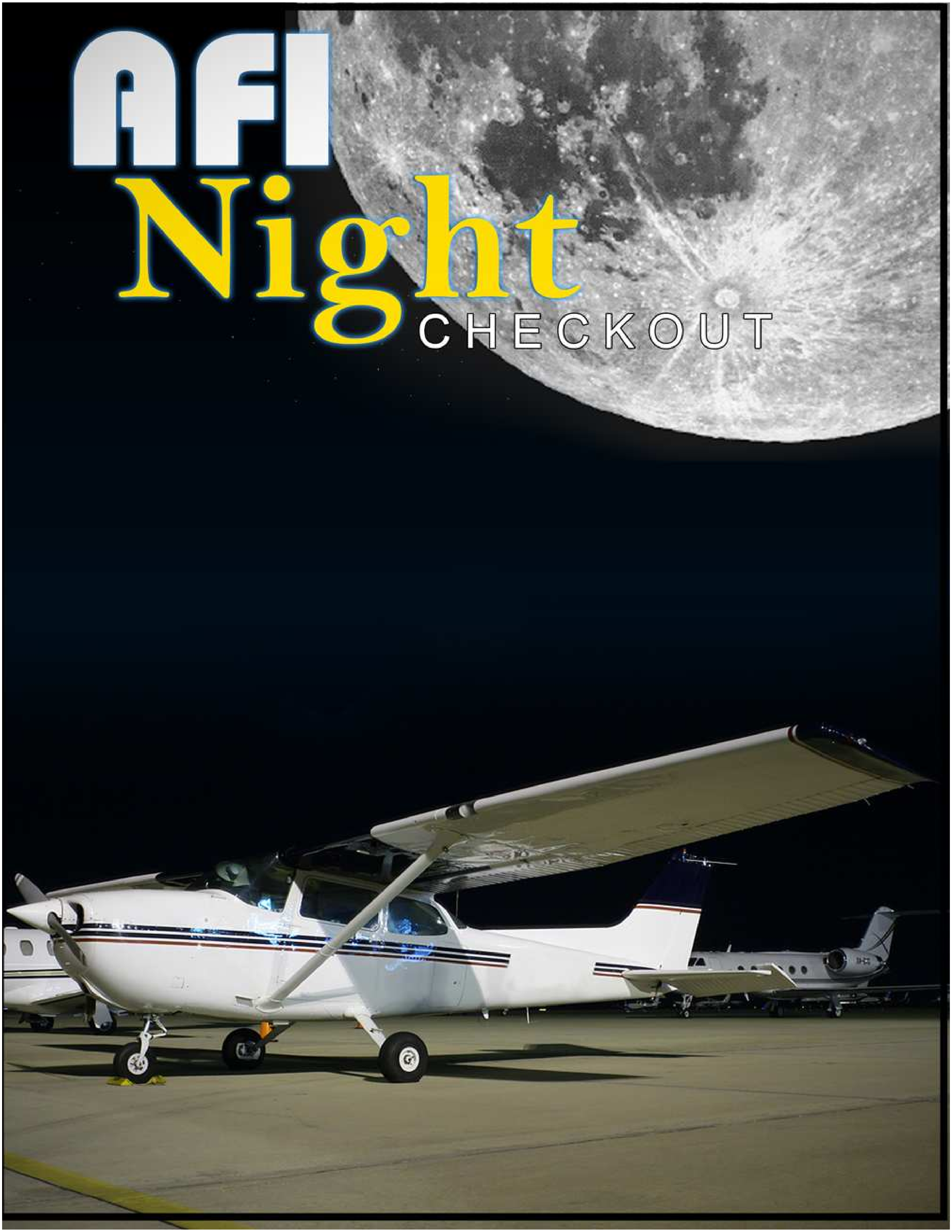
AFI Night CHECKOUT



Night Checkout Student Training Syllabus

Pickup Night Checkout syllabus from AFI
Read all assigned articles and information
Fill out Night Checkout worksheet
Schedule instructor and simulator for first session

Session 1-Ground and Simulator *1.0 on the ground* *1.0-in the sim*

Be prepared to discuss:

- Night flight-AFI policy
- Night vision-physiology
- Night illusions
- Required equipment
- Regulations
- Airport lighting
- Flight procedures
- Emergency procedures

<u>*Simulator Flight 1.0*</u>

Schedule instructor and airplane for 1 2hr block (30 minutes after sunset)

Session 2-Flight 1 Night procedures *.5-on the ground 2.0-in the air*

Come prepared having reviewed airspace and airport information for KLGB and KFUL
Bring flashlight
Get familiar with cockpit lighting before flight.
Do preflight
Meet instructor at the airplane

<u>*Preflight .2*</u>
<u>*Flight 2.0*</u>
<u>*Post flight .3*</u>

Totals: *Ground 1.0* *Dual 3.0* *Sim 1.0* *Instructor 1.0*

Aviation Facilities, Inc.
Night Checkout Worksheet

Student Name: ____

CFI Name: ____________________________________ Date: __________

Background: Night operations of aircraft by its nature, brings additional risk to the flight. By additional training and limitations, our goal is to manage those risks to maximize their safety. The checkout required at AFI is made to assure that the pilot can manage the aircraft safely to assure a successful flight. AFI has in agreement with our insurance carriers some additional limitations on night operations to limit the risk. These limits are in operational agreement and are listed below so you as a renter pilot will be better informed about these limitations. By signing the form you're stating that you have been informed of these limitations and will abide by them in all night operations.

Night Checkout as per AFI's Operational Agreement

Article 1, Section 2

To qualify as Pilot in Command (PIC) or as solo student pilot in an AFI airplane a renter pilot must pass a competency check for the conditions listed below, as considered appropriate to the certificates and ratings held, given by an AFI Flight Instructor:

Article 1, Section 2 (b)

For Night Flight. Thereafter, unless at least one hour as PIC in night flight with a minimum of 3 landings to a full stop have been logged within the preceding 90 days by a non student renter pilot, he must pass a recurrency check before he may again act as PIC at night. A student renter pilot may not operate an AFI airplane in solo flight at night.

11. Additional restrictions are place on night flight operations as follows:

a. For VFR flights, weather minimums of not less then 5,000 feet ceiling and 5-mile visibility
b. Non-instrument rated renter pilots are restricted to the magenta area depicted on the current Los Angeles Terminal Area Chart
c. Flights performed by instrument-rated or ATP renter pilots under weather conditions less than a. above or outside the area given in b. above shall be conducted under Instrument Flight Rules
d. No night circle to land approaches will be made in IFR conditions
e. A renter pilot shall not depart from an airport under weather minimums below those required for landing at that airport

1. Lights required for night flight? ____________________

2. What colors are the
   Rotating beacons, Civilian? ____________ Military? ____________
   Taxiway Edge Lights? ____________________
   Taxiway Center Light? ____________________
   Runway End Identifier Lights? ____________________
   Threshold Lights? ____________ Obstruction Lights? ________

3. Explain some problems and dangers associated with night flight. ____________

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____

4. What is the minimum fuel reserve for VFR night flight? ____________

5. How long should you wait after being exposed to bright light before takeoff, night adaptation? ____________________

6. What color light should you use for preflight? ____________
   for in flight use? ____________

7. What method should a pilot use when scanning for traffic during night flights? ______

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____

8. How should a pilot use the landing/taxi/strobe light during ground operation? ______

____

____

9. Why does the AIM recommend using OXYGEN above 5,000 feet at night? ______

____

____

10. What is the importance of the MEF figures on the charts? ____________

____

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Student's Signature: ____________________

CFI Signature: ____________________

Required Reading

NIGHT VISION

Generally, most pilots are poorly informed about night vision. Human eyes never function as effectively at night as the eyes of animals with nocturnal habits, but if humans learn how to use their eyes correctly and know their limitations, night vision can be improved significantly. There are several reasons for training to use the eyes correctly.

One reason is the mind and eyes act as a team for a person to see well; both team members must be used effectively. The construction of the eyes is such that to see at night they are used differently than during the day. 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 10-1]

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, but in the absence of normal light, the process of night vision is placed almost entirely on 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.

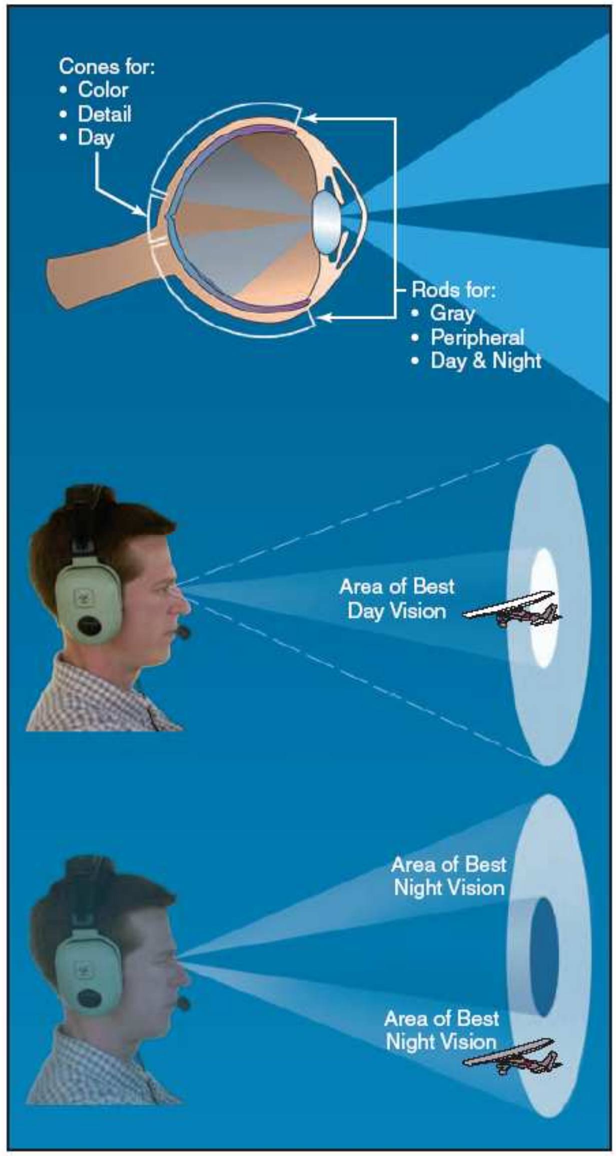

Figure 10-1. Rods and cones.

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. Most everyone has experienced this after entering a darkened movie theater. In this 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 the light than they were before the dark room was entered. Much more time, about 30 minutes, is needed for the rods to become adjusted to darkness, but when they do adjust, they are about 100,000 times more sensitive to light than they were in the lighted area. After the adaptation process is complete, much more can be seen, especially if the eyes are used correctly.

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 very 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.

The pilot before and during night flight must consider the adaptation process of the eyes. First, the eyes should be allowed to adapt to the low level of light and then they should be kept adapted. After the eyes have become adapted to the darkness, the pilot should avoid exposing them to any bright white light that will cause temporary blindness and could result in serious consequences.

Temporary blindness, caused by an unusually bright light, may result in illusions or after images 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 populated areas 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 adequate precautions should safeguard night vision.

In addition to the principles previously discussed, the following items will 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.
- If oxygen is available, use it during night flying. Keep in mind that a significant deterioration in night vision can occur at cabin altitudes as low as
- Close one eye when exposed to bright light to help avoid the blinding effect.
- Do not wear sunglasses after sunset.
- Move the eyes more slowly than in daylight.
- Blink the eyes if they become 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.

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.

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 will appear to be moving. The autokinesis effect will not occur if the pilot expands the visual field. It is a good procedure not to become fixed on one source of light.

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

A black-hole approach occurs when the landing is made from over water or non-lighted terrain where the runway lights are the only source of light. Without peripheral visual cues to help, pilots will have trouble orientating themselves relative to Earth. The runway can seem out of position (downsloping or upsloping) runway. If an electronic glide slope 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 will make 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 will be to fly a lower-than-normal approach. A good review of the airfield layout and boundaries before initiating any approach will help 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.

Pilot Equipment

Before beginning a night flight, carefully consider personal equipment that should be readily available during the flight. 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 D-cell size flashlight with a bulb switching mechanism that can be used to select white or red light is preferable. The white light is used while performing the preflight visual inspection of the airplane, and the red light is used when performing cockpit operations. Since the red light is nonglaring, it will not impair night vision. Some pilots prefer two flashlights, one with a white light for preflight, and the other a penlight type with a red light. The latter can be suspended by a string from around the neck to ensure the light is always readily available. One word of caution; 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 cockpit eases the burden on the pilot and enhances safety.

Airplane Equipment and Lighting

Title 14 of the Code of Federal Regulations (14 CFR) part 91 specifies the basic minimum airplane equipment required for night flight. This equipment includes only basic instruments, lights, electrical energy source, and spare fuses.

The standard instruments required for instrument flight under 14 CFR part 91 are a valuable asset for aircraft control at night. An anticollision light system, including a flashing or rotating beacon and position lights, is required airplane equipment. Airplane position lights are arranged similar to those of boats and ships. A red light is positioned on the left wingtip, a green light on the right wingtip, and a white light on the tail. [Figure 10-2]

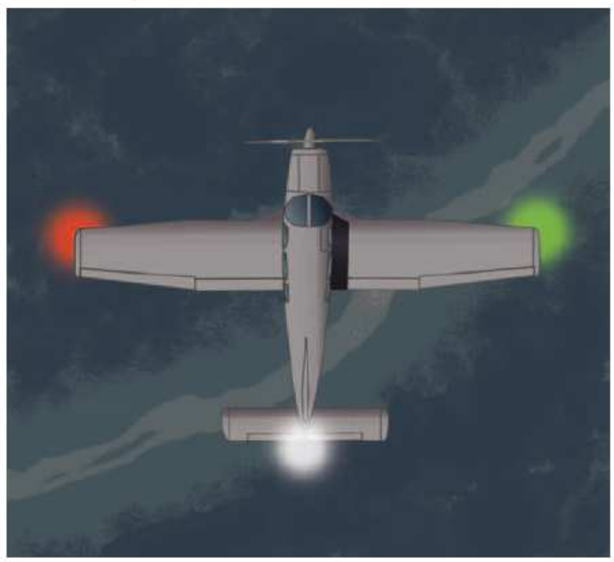

Figure 10-2. Position lights.

This arrangement provides a means by which pilots can determine the general direction of movement of other airplanes in flight. If both a red and green light of another aircraft were observed, the airplane would be flying toward the pilot, and could be on a collision course.

Landing lights are not only useful for taxi, takeoffs, and landings, but also provide a means by which airplanes can be seen at night by other pilots. 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 both 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 the stars or the lights of the cities at night and go unnoticed unless a conscious effort is made to distinguish them from other lights.

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 not to only know the exact location of an airport relative to the city, but also to 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*. 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 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 the 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 only needs to be concerned 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.

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/dewpoint spread. A narrow temperature/dewpoint spread may indicate the possibility of ground fog. Emphasis should also be placed on wind direction and speed, since its effect on the airplane 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 radio navigation aids and communication facilities add 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, for example, does not work.

All airplane 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 airplane. 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 cockpit 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 airplane position lights will serve 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 r.p.m. power settings normally used for taxiing may place an excessive drain on the airplane'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 airplane can be detected easily. At night, the airplane 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.

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 to a greater degree in controlling the airplane. This is particularly true on night takeoffs and climbs. The cockpit lights should be adjusted to a minimum brightness that will allow the pilot to read the instruments and switches and yet not hinder the pilot's outside vision. This will also eliminate light reflections on the windshield and windows.

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 airplane 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 airplane is aligned, the heading indicator should be noted or set to correspond to the known runway direction. To begin the takeoff, the brakes should be released and the throttle smoothly advanced to maximum allowable power. As the airplane 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 flight instruments should be checked frequently during the takeoff to ensure the proper pitch attitude, heading, and airspeed are being attained. As the airspeed reaches the normal lift-off speed, the pitch attitude should be adjusted to that which will establish a normal climb. This should be accomplished by referring to both outside visual references, such as lights, and to the flight instruments. [Figure 10-3]

Figure 10-3. Establish a positive climb.

After becoming airborne, the darkness of night often makes it difficult to note whether the airplane is getting closer to or farther from the surface. To ensure the airplane continues in a positive climb, be sure a climb is indicated on the attitude indicator, 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 and heading indicators. 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 after the airplane has climbed to an altitude where 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.

ORIENTATION AND NAVIGATION

Generally, at night it is 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 must be made through fog, smoke, or haze in order to land, the horizontal visibility is considerably less when looking through the restriction than it is when looking straight down through it from above. Under no circumstances should a VFR night-flight be made during poor or marginal weather conditions unless both the pilot and aircraft are certificated and equipped for flight under instrument flight rules (IFR).

The pilot should practice and acquire competency in straight-and-level flight, climbs and descents, level turns, climbing and descending turns, and steep turns. Recovery from unusual attitudes should also be practiced, but only on dual flights with a flight instructor. The pilot should also practice these maneuvers with all the cockpit 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 consumed. NAVAIDs, if available, should be used to assist in monitoring en route progress.

Crossing large bodies of water at night in single-engine airplanes could be potentially hazardous, not only from the standpoint of landing (ditching) in the water, but also because with little or no lighting the horizon blends with the water, in which case, depth perception and orientation become difficult. During poor visibility conditions over water, the horizon will become 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, thus making the horizon difficult to identify.

Lighted runways, buildings, or other objects may cause illusions to the pilot 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 10-4] 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.

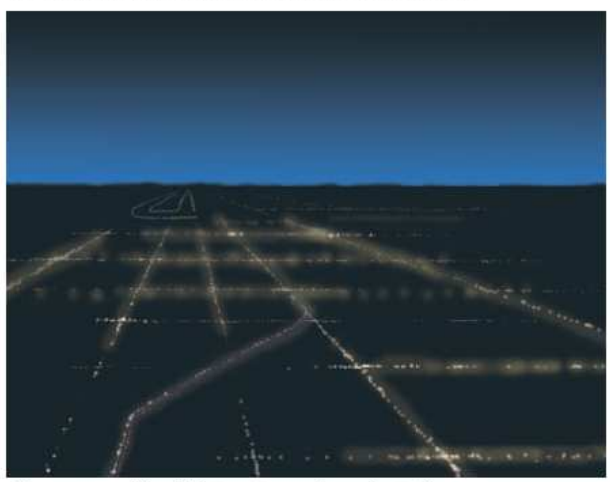

Figure 10-4. Use light patterns for orientation.

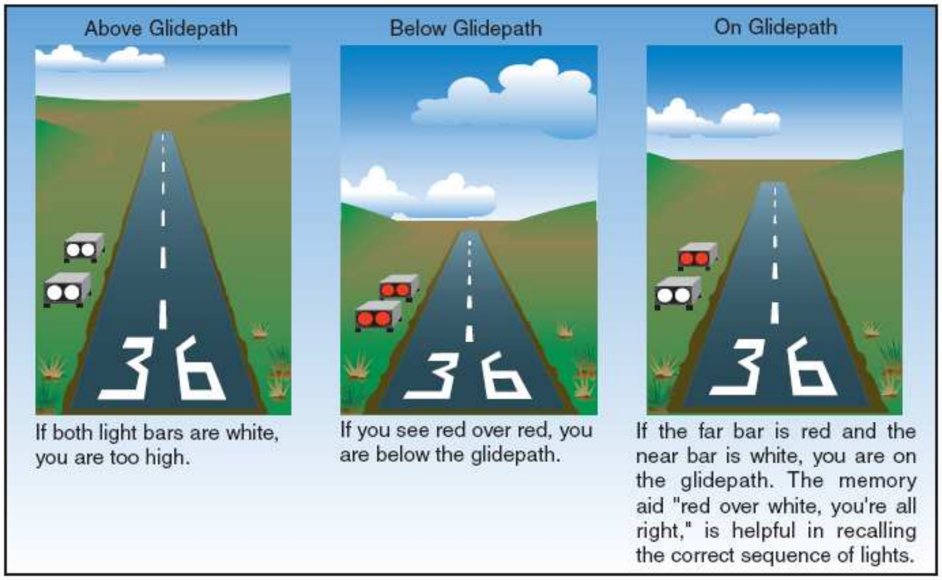

Figure 10-5. VASI.

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 will be 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 airplane's position along the base leg and final approach. A visual approach slope indicator (VASI) is an indispensable aid in establishing and maintaining a proper glidepath. [Figure 10-5]

After turning onto the final approach and aligning the airplane 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. Flaps should be used the same as in a normal 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 will usually 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.

The roundout and touchdown should be made in the same manner as in day 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 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 seen clearly. At this point the roundout should be started smoothly and the throttle gradually reduced to idle as the airplane is touching down. [Figure 10-6] During landings without the use of landing lights, the roundout may be started when the runway lights at the

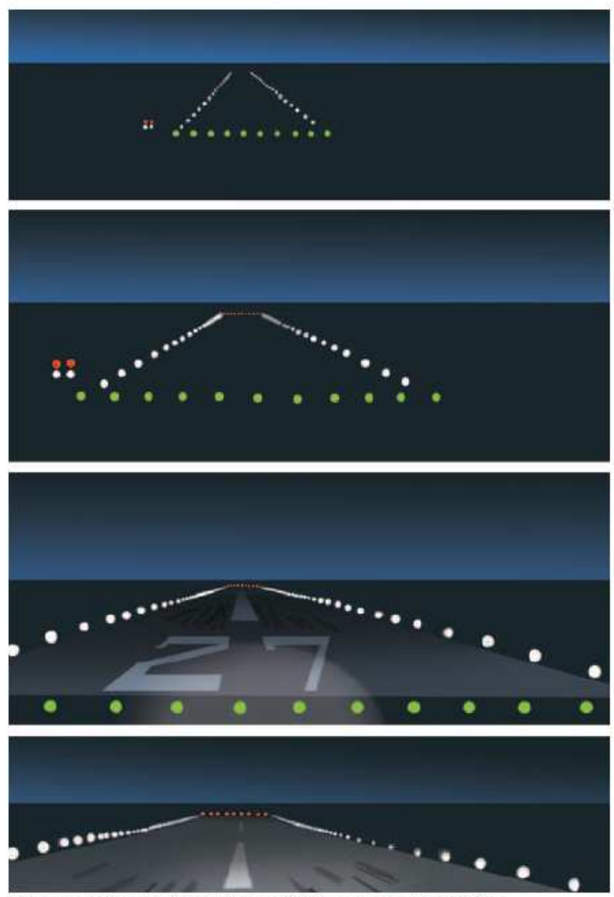

Figure 10-6. Roundout when tire marks are visible.

far end of the runway first appear to be rising higher than the nose of the airplane. 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 airplane 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 airplane 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 airplane and establish the best glide configuration and airspeed. Turn the airplane towards an airport or away from congested areas.

- Check to determine the cause of the engine malfunction, such as the position of fuel selectors, 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.

- If the condition of the nearby terrain is known, turn towards an unlighted portion of the area. Plan an emergency approach to an unlighted portion.

- 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 airplane should be held in level-landing attitude until the ground is contacted.

- After landing, turn off all switches and evacuate the airplane as quickly as possible.

Optional Reading

Flying's forgotten 5%

Preparation is the key to successful night flight

BY JOEL STOLLER (From *AOPA Flight Training,* September 2004.)

When was the last time you went out to the airport at night to do some touch and goes and brush up on your night flying skills? To fulfill the night currency requirements to carry passengers, they actually need to be full-stop landings, but we'll explore the regulatory aspects of night flying a little later.

Ninety-five percent or more of flight time logged by private pilots takes place in daylight. This statistic seems to warrant a close review of night flying techniques, since we seem to fly at night so infrequently. As members of the human species and from a physiological point of view, we are better adapted for daytime activities.

Anatomy textbooks speak of human vision comprising two types: photopic vision for daytime and scotopic vision for nighttime. The visual receptor cells packed into the eye's retina are called *cones* and rods; they convert light into the electrical energy needed to generate nerve impulses conducted through the optic nerves. Only about 10 percent of the light that enters the eyes reaches the receptor cells — most of it is reflected or absorbed in other parts of the eye. There are about 7 million relatively thick cones in the human eye used for daytime, or what could be termed color, vision and about 120 million slender rods used for night vision. The low illumination of nighttime de

mands a huge increase in these receptor cells in order for any light reception to take place at night.

Chapter 8-1-6 of the *Aeronautical Information Manual*, Medical Facts for Pilots, addresses a few concerns of pilots while operating at night. In darkness, vision becomes more sensitive to light; a process called *dark adaptation*. Dark adaptation usually takes 30 minutes in total darkness, but it can be achieved in 20 minutes under dim red cockpit lighting. Red light severely distorts colors on aeronautical charts and causes difficulty when trying to focus on objects inside the cockpit, so white cockpit lighting is necessary for chart and instrument reading and should be used as necessary — but keep the overall cockpit illumination at your lowest comfortable level. Cabin altitude pressures above 5,000 feet, smoking, exhaust fumes (carbon monoxide), and vitamin A deficiency also impair dark adaptation.

Sudden exposure to a bright light ruins dark adaptation within seconds, so pilots should close one eye when a light (for example, a flashlight in the cockpit) is used, to preserve some degree of night vision.

Night for aviators is defined as "the hours between the end of evening civil twilight and the beginning of morning civil twilight, as published in the American Air Almanac, converted to local time." Note that "civil twilight ends in the evening when the center of the sun's disk is 6 degrees below the horizon and begins in the morning when the center of the sun's disk is 6 degrees below the horizon."

So now you know exactly when you should log night time. Remember, to act as pilot in command while carrying passengers, you must have made at least three takeoffs and landings to a full stop in the preceding 90 days in the same aircraft category, class, and type, during the period beginning one hour after sunset and ending one hour before sunrise.

Thomas Edison's invention of the light bulb is the little miracle that makes all of this night activity possible. What lights do you need to fly safely at night? Common sense dictates the answer here, but some are regulatory in nature. A safe nighthawk always carries at least two working flashlights in the flight bag and a penlight in his or her pocket. Next is to be sure that all required aircraft lights for night operations are installed and working. Check all lights on your preflight walk-around. These include the position lights (or what are sometimes placarded *navigation* or *nav* lights): left wing red, right wing green, and aft or tail position white. These position lights must be on from sunset to sunrise. An anticollision light system is also required for night (and day) operations, which may include one or more strobe and/or rotating beacons that may be colored either red or white.

If your aircraft has a rotating beacon and supplementary strobes, keep the strobes off until cleared for takeoff. Use the "lights, camera, action" (lights on, transponder on, power normal and airspeed alive) callout to help you remember this as you acknowledge takeoff clearance from the tower, or when you are ready to take the active runway at an airport without an operating control tower. Strobes on at night while taxiing can harm other pilots' night vision.

This is also the time to turn on landing lights to bring attention to the fact that you are rolling on takeoff. (Some single-engine aircraft have a dual taxi/landing light configuration, with the taxi light either a lesser wattage lamp or aimed more toward the near foreground area ahead of the aircraft's taxi path). Remember that other aircraft operating on adjacent taxiways or runways may not be monitoring the same frequency or controller from whom you just received your takeoff clearance.

While getting some currency at night with an instructor, simulate a "burned out" landing light approach and landing to a full stop. It can and does happen — and may happen to you some night for real. You must now gauge your depth perception in the landing flare with the white runway edge lights, as there will be little forward illumination. Being prepared for any eventuality is the only way to operate safely in a world ruled by "Murphy's Law" — anything that can go wrong, will go wrong. If you have access to a realistic night simulator, practice a few of these in the simulated environment. If you regularly use simulators at your flight school to supplement training, choose the night simulation if available to increase your confidence in a night cockpit and night flight scenario.

If aircraft marshallers (usually line personnel from the fixed-based operator) are available at your airport for parking and exiting parking areas, use them as a safety resource at night. This is part of a wide-ranging use of cockpit resource management, as every pilot should employ every available resource to enhance safety. The hand signals are the same for night or day operation (found in Section 4-3-25 of the AIM); marshallers employ red-lighted wands at night.

Blue surface lights indicate the edges of taxiways, and larger airports have green taxiway centerline lighting as well. Always check local notices to airmen (notams) before night operations to determine the status of an airport's taxiway and runway lighting. Occasionally, segments of taxiway lighting may be inoperative, adding a new hazard to taxiing at night — the line between pavement and grass may be extremely difficult to see or determine. Use caution, and taxi slowly.

I have come to the conclusion after many hours of night flying in VFR conditions that there are four major concerns that must be addressed in your night flight training and any subsequent night flying you do after earning your private pilot certificate. Number one is the optical illusion that occurs while flying on clear moonless nights over sparsely populated areas. (Interestingly, this phenomenon is also readily seen at jet cruising altitudes.) The widely spaced lights below, such as street lamps or home porch lights, seem to blend with visible stars above the horizon, making it difficult to ascertain where the actual horizon is to establish the proper reference for straight-and-level flight. Obviously this can lead to spatial disorientation in the cockpit while trying to establish a level pitch attitude or to complete turning maneuvers using visual cues. The lack of visual cues at night is one reason that night flying is often compared to instrument flight. Nearer to metropolitan areas or in the airport environment, this appears to be less of a problem, because ground lighting better defines the actual horizon. If you ever begin to feel disoriented at night, use your artificial horizon and airspeed and altimeter trends to regain control while disregarding false motion sensations created by your inner ear balance system. This is a fundamental precept of instrument flying.

The next night caution for pilots is another disorienting phenomenon in VFR conditions (exacerbated by a little summertime haze) that results when flying toward a large body of water. As the shoreline is reached and the ground below you disappears, the horizon is now basically lost, and you are essentially flying in "instrument conditions" even though the visibility may be reported as six miles or better. While approaching and landing at an airport with featureless terrain and few ground lights (sometimes called "the black hole approach"), an illusion can be created that the aircraft is at a higher altitude than it actually is (see "Bottomless Pit," October 2003 *AOPA Flight Training*). Obstacles in the approach path near the runway threshold, such as 50-foot trees, are difficult to see clearly at night until you are virtually just above them. Always use the VASI/PAPI light system for glidepath guidance, and if this is not available, keep rates of descent the same as you would during a normal daylight approach and landing (500 to 700 fpm rate of descent on final). Remember the basic VASI memory cue: "Red over white — you're all right, red over red — you should dread."

The third night caution involves obstacles. These come in a variety of forms, including buildings near approach paths, TV/radio antenna towers, and electrical utility towers. The most commonly observed obstacle lighting is "aviation red obstruction lights," flashing aviation red beacons that flash 20 to 40 times per minute or burn steady red on structures not taller than 200 feet. The next type you have observed is "medium or high intensity flashing white obstruction lights" on structures 500 feet or higher. A word of caution here: If the obstruction happens to be a TV/radio antenna tower, there may be guy wires (steel cables) radiating from the top of the structure down to the ground, 360 degrees around the structure. These are not lighted in any way, and they may be impossible to see at night. So keep a safe distance away from these structures (1,000 feet above within a horizontal radius of 2,000 feet) and you'll avoid any cables that may extend horizontally from the lighted vertical structure. What you can't see may definitely hurt you! These obstacles are clearly marked on VFR sectional charts — be sure that your charts are current and always check notams before flying, as the "information age" is creating an ever-increasing amount of new communications towers.

The final major concern of most pilots flying at night is engine failure. Engine failure in good weather and daylight conditions is challenging enough. Now add some of the additional hazards that we have been discussing to the picture, and to quote a phrase, "You definitely have your hands full." Assuming a restart is not possible and you are not within gliding distance of an airport, more altitude always allows you more time to come to a suitable decision on the best off-airport site for landing. Your procedures are basically the same as if the emergency occurred in daylight, and choosing an obstacle-free field, landing into the wind, is the ideal choice. However, determining which obstacles lurk below at night may not be possible. Use your best judgment during the evaluation phase, and concentrate on flying the airplane, maintaining airspeed and airplane control on final. A sparsely lit two-lane road may look suitable, but remember the hidden hazards of telephone and electrical poles and wires bordering or crossing the road.

En route, if you see a red wingtip position light, it's on the right of the other aircraft and the traffic is approaching. Diverging traffic would show the opposite, and you would also see the white aft position light.

Approaching your destination airport, the tower may not be operating during the midnight hours, so you may need to activate the runway lighting via the com-radio-controlled pilot controlled lighting (see AIM Section 2-1-6 for more). These systems are installed at many nontowered airports as well. If you key your microphone seven times within five seconds on the designated frequency (usually CTAF or tower frequency), the highest intensity available will activate, including VASI/REIL (visual approach slope indicator/runway end identifier lights), approach lighting, and all runway and taxiway lights. Five times within five seconds yields medium intensity, and three times within five seconds activates the lights at low intensity. Fifteen minutes' lighting duration is now available.

The airport rotating beacons for civilian use alternate white and green. Don't confuse this with a military airport beacon that alternates white, white, and green. Your VFR night destination may have a military field nearby, so be familiar with any military operations areas along your route. (See "CFI to CFI: Blackout Dates Apply," for a discussion of military nighttime operations and GA pilots.)

Another classic "trap" during night cross-country flights occurs when there are two airports relatively nearby (within 20 nm of each other) that have similarly configured runways. Many pilots have lined up perfectly for a straight-in approach to one airport's runway only to realize that what really lies ahead is another airport 10 miles from the intended destination. Even professional pilots have made this mistake. Use standard technique when approaching an uncontrolled airport at night, circling 1,500 feet above field elevation to view the lighted wind tee or windsock if there is one, before entering the pattern. The current *Airport/Facility Directory* lists all of these important details about what is available at destination airports that you must incorporate into your preflight planning.

The basic flying techniques and procedures for day and night flying are essentially the same. Flying fundamentals never change. Your airplane doesn't know whether the moon is out or not, but the stage on which you are performing has a definite new look at night.

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Pilot Counsel

Night flying and the FARs

BY JOHN S. YODICE (From *AOPA Pilot*, October 2005.)

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What is night flying under FAR Part 91 (general operating and flight rules) and Part 61 (certification of pilots and instructors) could be confusing because night is defined or described differently in different places in the regulations. What helps obviate the confusion is pointing out the not-so-obvious fact that it is only in two significant places where it is different from the technical regulatory definition of "night."

FAR 1.1: Definition of night

The technical regulatory definition of night, FAR 1.1, is "the time between the end of evening civil twilight and the beginning of morning civil twilight, as published in the American Air Almanac, converted to local time." Civil twilight ends in the evening when the center of the sun's disk is 6 degrees below the horizon and begins in the morning when the center of the sun's disk is 6 degrees below the horizon. That's getting pretty dark, as pilots familiar with the horizon understand. The American Air Almanac contains tables that show evening civil twilight and morning civil twilight for different latitudes. According to the FAA, knowing the latitude in which we are located, and using these tables, we can determine when evening civil twilight ends and morning civil twilight begins. We can then convert these figures into local time, and calculate the time spent in night flying accordingly. Most of us rely on tables published in weather reports or local newspapers, or on television or the Internet. Most of us are satisfied that these approaches, applied conservatively, meet the intent of the regulations.

This technical regulatory definition (not the two exceptions), applies to such important regulations as VFR weather minimums, VFR fuel requirements, and pilot certification requirements for night flight training.

Night VFR weather minimums

The basic VFR weather minimums of FAR 91.155, which are complicated, yet which every pilot is held to know, for the most part do not differentiate between night and day. It is only for operations in Class G (uncontrolled) airspace that the regulation specifies some higher minimums for night flight. The minimums in the other classes of airspace, all controlled (Classes A, B, C, D, and E), are the same, night and day.

The daytime minimums for Class G airspace (below 10,000 feet msl and above 1,200 feet above the surface) are visibility of 1 mile and clearance from clouds of 500 feet below, 1,000 feet above, and 2,000 feet horizontal. At 1,200 feet or less above the surface (regardless of msl altitude) the daytime cloud clearance minimum is "clear of clouds." That's pretty significant. At or below 1,200 feet agl in uncontrolled airspace, we can operate daytime VFR with as little as one-mile visibility and clear of clouds.

At night, the visibility minimum for uncontrolled airspace increases to three statute miles for both altitude spectrums, making it the same as in controlled airspace. The cloud clearance minimums at night, while the same as controlled airspace for operations above 1,200 feet above the surface, increase for lower altitude operations from "clear of clouds" to the same as controlled airspace, i.e., 500 feet below, 1,000 feet above, and 2,000 feet horizontal distance from clouds. So, at night, the VFR weather minimums in all uncontrolled airspace up to 10,000 feet msl are the same as controlled airspace. In other words, there are no relaxed VFR weather minimums at night in uncontrolled airspace.

Helicopters are a special case. Day or night in uncontrolled airspace, a helicopter may be operated clear of clouds if operated at a speed that allows the pilot adequate opportunity to see any traffic or obstruction in time to avoid a collision. Another special case is airplanes (or powered parachute or weight-shift-control aircraft) in an airport traffic pattern in uncontrolled airspace. If an airplane is operating at night in an airport traffic pattern within one-half mile of the runway, it may operate with as little as one-statute-mile visibility.

Night VFR fuel requirements

The fuel requirements for flight in VFR conditions, as specified in FAR 91.151 (see "Pilot Counsel: VFR Fuel Requirements," January 2000 Pilot), are increased for night operations. At night, a flight under VFR conditions must begin with enough fuel to fly to the first point of intended landing, and to fly after that for at least 45 minutes assuming normal cruising speed. The daytime minimum is 30 minutes. The fuel requirement for rotorcraft VFR flight is not different for night. Day or night, the flight must begin with 20 minutes fuel reserve. As a reminder, in computing these fuel requirements a pilot must consider wind and forecast weather conditions. The fuel requirements for flight in IFR conditions are not different for night or day.

Certification rules for night flying

A specified amount of night flying is required for certification as a private or commercial pilot. For example, under FAR 61.109, an applicant for a private pilot certificate must generally (there are restrictive exceptions) have at least 3 hours of night flight training that includes a long cross-country flight and 10 takeoffs and 10 landings in a single-engine or multiengine airplane, depending on the rating sought. Under FAR 61.129, an applicant for a commercial pilot certificate has comparable night flight-training requirements and exceptions. There are similar night flight-training requirements for helicopter and other ratings. All of this night time is required to be computed with reference to the technical regulatory definition of night in FAR 1.1.

Recent experience requirements

On the other hand, here is one of the places that the definition of night is different from the FAR 1.1 definition. FAR 61.57(b) contains the recent night-flying experience requirements to carry passengers at night. The title of the regulation uses the term "night" but only implicitly defines that term as the "period beginning one hour after sunset and ending one hour before sunrise." This definition is narrower. It makes shorter the period of darkness when this night flying experience may be gained.

To refresh, the rule requires that a pilot must have made at least three takeoffs and three landings to a full stop during nighttime, as it is here narrowly defined, in order to be current to carry passengers during a nighttime period defined in the same way. The required takeoffs and landings must have been made in an aircraft of the same category, class, and type (if a type rating is required), or in an approved training center simulator adjusted to simulate night.

Night special VFR

The opportunity to operate special VFR under FAR 91.157 — that is, with lower than basic VFR weather minimums — is more restrictive at night. The term "night" does not appear in this regulation. Rather, it is implied because according to the regulation special VFR operations may only be conducted "between sunrise and sunset" — unless the flight meets other criteria. So, essentially it is a nighttime restriction, night being implicitly defined as the time other than "between sunrise and sunset." Unless the operation is between sunrise and sunset, a special VFR operation may not be conducted unless the aircraft is equipped for IFR flight and the pilot is IFR rated and current. During daytime special VFR operations, these IFR restrictions do not apply. The IFR restrictions do not apply to helicopters. In Alaska, the IFR restrictions apply unless the operation is when the sun is six degrees or more above the horizon.

In-Flight Emergencies

Night Forced Landings

When nighttime is the worst time

BY PETER A. BEDELL (From *AOPA Pilot*, November 1999.)

IMMEDIATE ACTION ITEMS

Assuming you've tried everything to restart the engine:

- Airspeed — BEST GLIDE
- Mixture — IDLE CUTOFF
- Fuel — OFF

Prior to touchdown:

- Magnetos — OFF
- Master — OFF
- Doors — UNLATCH

The point of this yearlong In-Flight Emergencies series of articles is to look at the worst-case scenarios. And when it comes to flying small airplanes, there's not much that's worse than having to make a forced landing at night. We covered forced landings in the February installment of this series from a more general standpoint (see "In-Flight Emergencies: Forced Landings," February *Pilot*). In that article we looked at different landing sites and stressed the importance of not panicking.

Let's face it, most aircraft owners and pilots who fly for pleasure are going to do it during the day; that's just the way it usually works out. Although it's not the only factor affecting the decision, most pilots are aware of the increased risk of flying at night and elect to fly during the day to minimize that risk.

It's somewhat unfortunate that nighttime flight is potentially more hazardous, because flying in the dark has lots of advantages: It's usually smoother because thermal heating is at a minimum; traffic is lighter, allowing more freedom in routing; and other airplanes are generally easier to see. When everything is working well, night flight is one of the most peaceful and pleasurable flying experiences. And given the reliability of the engines that power our airplanes, night flight is statistically a very safe operation. Interestingly, the AOPA Air Safety Foundation's *1998 Nall Report* shows that the overall — and fatal — accident rates per 100,000 hours flown were lower in night visual meteorological conditions (VMC) than during day VMC flights. This is likely because those flying at night tend to be professional pilots, whereas the day-trippers tend to recreational pilots. In instrument meteorological conditions, there were more total accidents at night, but fewer people lost their lives at night than those flying in the clouds during the day. Again, these figures depend on many factors such as the ratings and experience of the pilots making those trips, but then reinforce the fact that night flight can be just as safe as daytime flights.

In a single, if your engine quits at night, you're in a whole heap of trouble, especially if the weather is poor. We pilots are our own worst enemy when it comes to engine stoppages. Pilots who run tanks dry (fuel starvation) or run out of fuel completely (fuel exhaustion) cause the majority of engine failures. Pilots who practice conservative fuel planning and have a good understanding of the fuel system of the airplane they fly drastically reduce the chances of having a pilot-induced engine stoppage. Regardless of whether you caused the engine to fail or Murphy's Law has made you the chosen one this evening, you've got a serious problem.

The first thing to do is to set up the airplane for the best-glide speed and trim it to fly hands-off. Run through the engine failure checklist to attempt to get the engine running again. For the purposes of this article, we'll assume that the engine will not relight, and that you will have to make a forced landing. Your first question should be, "Where am I?" If you're totally dependent on GPS, and it's not equipped with a moving map, you may not have the foggiest clue where you are — all you know is that you are 173 miles west of your home airport. You can punch the nearest-airport button on your GPS or loran unit. If your aircraft isn't so equipped, hopefully you had your finger following along on a chart, or some nearby VORs tuned in to quickly triangulate your position.

GPS units with terrain databases that feature roads, lakes, and other cartographic depictions could prove helpful in such a situation. With one of these units, you may be able to determine whether that dark spot below you is a lake. And if it's a lake that you suspect is surrounded by trees, then ditching in the lake becomes your best option for a forced landing. Since it's very hard to determine your height above water at night, the glassy-water-landing technique used by seaplane pilots would come in handy here.

If you are IFR or receiving VFR traffic advisories, call the controller and declare an emergency, pronto. (If you are flying VFR on your own, which is not such a good idea at night, then transmit a Mayday call on 121.5 MHz.) Squawk 7700 on the transponder and ask the controller where the nearest airport is. If it's IFR, find out where the best weather is. If there isn't any, then you'll have to head for the most benign terrain available and hope that when you break out you can maneuver to a safe landing spot. If you're over mountains, cold (but not frozen) water, or forest, the outcome looks more dismal. On the other hand, if you're over a dry lake bed, flat terrain, or a thoroughly frozen body of water, then consider yourself lucky. For example, if your engine quits over Nebraska, you have a darn good chance of setting down in a nice wheat field and walking away without a scratch on you, your passengers, or your airplane.

Analyzing the terrain at night takes a sort of sixth sense if there's no moon or the airplane does not have weather radar to map the terrain. Is that dark spot on the ground a lake, a forest, or a field? Wouldn't it be great to have a set of night-vision goggles that the armed forces use? Seriously, these vision enhancers are now being sold to the public at a cost that's far less than going out and buying a twin for night-flying security. We haven't tested a set in an airplane yet but would think that a set could help.

If it's a moonless or overcast night, ambient light is nil and you may be forced to make some tough choices. In such cases, lighted roads or highways can be your savior. Of course, landing on a road opens you up to the chance of harming drivers, so be very cautious about executing your forced landing on a road.

When setting up to land on or near a road, be wary of power lines and overpasses. If it looks doubtful that you can make it over these obstacles, you should plan to go under them. Trying to stretch the glide over the obstacle could lead to a stall, whereas going under the obstacle with extra speed allows you to remain in full control of the airplane.

Hopefully, automotive traffic will be light and you can land on the pavement. To minimize the potential for a collision with a vehicle, it's best to land in the same direction as the traffic on a divided highway. Light singles approach and land at speeds nearly identical to highway speed limits, making the airplane's ability to merge with light traffic a definite possibility. If you land against traffic in the hopes that somebody will see the landing light(s) and pull off the road, you're putting too much faith in the ability of drivers to act quickly to something they've probably never seen before. By the time the driver sees your landing light it'll be too late, and instead of a collision at or near the same speed, you could be looking at a head-on collision with a vehicle that's twice as heavy as your airplane.

If the highway has a level median strip, you may be able to land there with little or no chance of hurting anyone or anything. Even if the median is beveled, you should still consider landing there since it's better to break up your airplane a little than cause a multi-car pileup on the interstate.

In June, a near-catastrophe for all of GA occurred when a Cessna 402A made a daytime forced landing on a busy Van Nuys, California, road. According to the NTSB preliminary report, the twin Cessna rolled down the road, running a red light at an intersection where two school buses filled with children were crossing in opposite directions. The 402's tip tanks were sheared off as it hit the front ends of the two school buses. The airplane slid to a stop soon afterward. One bus driver and one child were injured. There was no fire. Why? Because the NTSB preliminary report indicated that there was no fuel in the 402's tip (main) tanks. It's amazing how one pilot's poor planning could have affected so many innocent people. To read a copy of the NTSB report, see the Web site (www.ntsb.gov/aviation/LAX/99A225.htm).

As this accident illustrates, pilots of twins aren't immune from forced landings. If one engine of a twin packs it in, depending upon cruising altitude and load, the pilot may not be able to maintain altitude. For example, if the single-engine service ceiling of your twin is 4,500 feet and you're flying over 6,000-foot peaks at 7,000 feet when one engine quits, you'd better find an airport in a valley — quickly. Even while maintaining the best single-engine rate of climb speed, the airplane will gradually begin descending to its new service ceiling — which will depend on a number of factors such as density altitude, load, and pilot technique. If you are forced to descend into clouds filled with ice, you may be committed to an off-airport landing just like the pilot of a single.

In order to survive this "nightmare of aviation nightmares," pilots need to start at the planning phase. For example, taking a flight at night over mountains with questionable weather should raise a red flag or two in your mind. What will be your escape plan? Cruising at higher-than-normal altitudes to be within gliding distance of an airport is a good start, but keep in mind that the body is more susceptible to hypoxia as altitude increases. Bring that oxygen bottle. Also utilize ATC whenever possible by using VFR flight following or by filing IFR. Following these basic tips can make night flight a less-puckering, yet more pleasurable, affair.

Tips to Survive a Night Forced Landing

Preflight planning for a night flight with a new pilot at the controls should include checking the moon's phase. Flying on a clear night under a full moon can provide adequate light to see a distinct horizon, as in the daytime. And if the engine quits, a full moon makes a successful forced landing a stronger possibility.

Much thought should be given to the **route and altitude** that you choose for a night flight. If there is a perfectly good interstate highway to follow that's only five miles parallel to your course, then it would be foolish not to fly within gliding distance of it. Barring factors such as weather and availability of oxygen, it would be prudent to fly at a higher altitude at night in a single-engine airplane. Even if your airplane's best altitude for cruise is 7,000 feet, it may be a good idea to climb to 9,000 feet so the airport 15 miles off your right wing could be reached in the event of a power loss. However, night vision degrades rapidly at night at higher altitudes. Consider using supplemental oxygen above 5,000 feet.

Use ATC traffic advisories or file IFR on night flights in order to have a controller's assistance at the key of a mic. Throughout much of the United States, you'll be in radar coverage, allowing a controller to be your eyes and ears in the event of an emergency. ATC can provide vectors to the nearest airport, call local police, and provide critical location data to search-and-rescue teams for a quick rescue.

Follow the progress of your flight on a chart or buy a good moving-map GPS. A GPS can also figure out what the wind is doing. If you can lower your groundspeed on landing by as little as 10 knots by landing into the wind, your chances of survival increase exponentially. If your airplane has radar, it can be used to map terrain so that you can guide yourself into a valley. Weather radar will also depict lakes and other bodies of water quite well.

Besides the handheld GPS, a portable transceiver, a couple of good flashlights, and a minimal survival kit should be considered mandatory. Electrical failures, fires, and other emergencies that have been discussed all year in the In-Flight Emergencies series are compounded if they occur at night. Having these simple tools is important in minimizing the risk of night flying.

Be aware of **surface conditions** along your route. What kind of terrain are you over? What are the winds doing? Listen to ATIS and AWOS reports at airports that you pass by. Not only is this a great way to learn about weather in general, but it'll keep you apprised of the surface winds in case a forced landing becomes necessary.

Switch fuel tanks when you are near an airport. Fuel-starvation accidents often result from a fuel selector that was placed in the wrong position. Combine a dark cockpit with a fatigued pilot who misused the fuel selector, and the recipe for an engine stoppage is complete. If for some reason the engine does not want to start again, you'll at least be over an airport.

Go to the light. If you're in the middle of nowhere, and lights are few and far between, it would be a good idea to head toward any visible light. Lights mean people — people who can save your life if needed. Constantly think of what to do after a crash. Not only does this levelheaded thinking keep your mind on surviving the ordeal, it may be the key to your getting any help in a reasonable amount of time.

This is obvious, but being intimately **familiar with the airplane** you're flying is crucial. Best-glide speed should be etched into your mind, and it's a real good idea to look in the POH and memorize how far your airplane will glide in the event of an engine failure.

If your airplane is equipped with a panel-mounted **ELT switch,** turn it On when you've committed yourself to a forced landing. ELTs are designed to trip themselves upon impact, but it would be wise to get the troops out as soon as possible for a quick rescue. (You *have* been replacing that battery every two years, right?)

Prepare yourself and your passengers for the impact by **cinching the seatbelts** as tightly as possible. Lap belts should be low around the hips; shoulder belts should be secure and as tight as possible.

Stay under control up to the moment of truth. Forced-landing fatalities occur when the pilot ends up stalling the airplane while trying to *stretch* the glide. — *PAB*

Links to related stories can be found on AOPA Online (www.aopa.org/pilot/links/links9911.shtml).

Landmark Accidents: Vineyard Spiral

Low visibility contributes to JFK Jr.'s accident

BY BRUCE LANDSBERG (From *AOPA Pilot*, September 2000.)

The official NTSB report on the John F. Kennedy Jr. accident was released almost one year after the crash, an event that caused intense media and public scrutiny of general aviation — particularly regarding VFR flight at night. On July 16, 1999, at about 9:41 p.m. Eastern Daylight Time, a Piper Saratoga, N9253N, carrying JFK Jr., his wife, and his sister-in-law plunged into the Atlantic Ocean approximately seven and a half miles southwest of Martha's Vineyard, Massachusetts.

The weather played an important part in this accident and appeared to be benign. The NTSB and National Weather Service determined that the weather at the crash site was VFR. It will become obvious with hindsight that this was not a good flight for a new VFR pilot to undertake. Even with considerable instrument training, the pilot was unable to maintain control, and this accident underscores the need for caution, especially when flying over water and sparsely populated areas after dark.

Flight history

The flight originated from Caldwell, New Jersey (CDW), with a planned stop at Martha's Vineyard Airport (MVY), where Kennedy's sister-in-law was to be dropped off. The final destination was Hyannis, Massachusetts (HYA).

Kennedy informed an FBO employee in the early afternoon that he planned to depart Caldwell at around 6 p.m. Another pilot who was also heading out to the islands that night said that the auto traffic was the "second heaviest he had ever seen" and, as a result, he was delayed almost an hour beyond his own planned departure time. Traffic likely contributed to Kennedy's delayed departure.

Witnesses at Caldwell saw Kennedy using crutches as he loaded luggage aboard the Saratoga. Air traffic control transcripts showed that the flight departed at 8:38 p.m. It was nearly dark. After a quick discussion with the tower regarding the departure route, there was no further communication between the aircraft and ATC or flight service for the rest of the flight.

Radar data was used to reconstruct the flight path and, at 8:40 p.m., a VFR transponder target thought to represent N9253N was observed about one mile southwest of Caldwell at an altitude of 1,300 feet. The target proceeded to the northeast, on a course of 055 degrees, and climbed to 1,400 feet when it reached the Hudson River. Eight miles northwest of the Westchester County Airport in White Plains, New York, it turned north over the river. Shortly after that it turned eastward on a course of 100 degrees, climbing to 5,500 feet. The flight passed just north of Bridgeport, Connecticut, and crossed the shoreline between Bridgeport and New Haven, Connecticut. The ground track paralleled the Connecticut and Rhode Island coastlines; passed Point Judith, Rhode Island; and continued over the Rhode Island Sound.

About 34 miles west of Martha's Vineyard the radar data indicated that the flight began a descent from 5,500 feet. The speed during descent was calculated to be about 160 knots indicated airspeed, and the rate varied between 400 and 800 feet per minute. At approximately 9:38, the flight began a right turn in a southerly direction. About 30 seconds later, the descent stopped at 2,200 feet and the target began a climb that lasted another 30 seconds.

During this time, the target stopped the turn, and the airspeed decreased to about 153 KIAS. About 9:39, the target leveled off at 2,500 feet and flew southeasterly. About 50 seconds later, the target then entered a left turn and climbed to 2,600 feet. As the left turn continued, it began to descend at about 900 fpm. When the target reached an easterly direction, it stopped turning; its rate of descent remained about 900 fpm. At 9:40:15, while still in the descent, the target entered a right turn. By 9:40:25, the bank angle exceeded 45 degrees, the vertical acceleration was 1.2 Gs, the airspeed increased through 180 kt, and the airplane's nose was pitched down about 5 degrees.

After 9:40:25, the airplane's airspeed, vertical acceleration, bank, and dive angle continued to increase, and the right turn tightened until water impact, at about 9:41. The last radar hit at 9:40:34 showed an estimated descent rate of more than 4,700 fpm. There were no survivors.

Wreckage information

The wreckage was located in 120 feet of water about one-quarter of a mile north of the target's last recorded radar position. The Saratoga, based on radar and information obtained from the wreckage, struck the water with its right wing low, in a steep nose-down pitch attitude. The recovered attitude indicator showed a 125-degree right bank and 30 degrees nose low.

Data from the flight and engine instruments showed that the engine was developing power at the time of impact. The tachometer indicated 2,750 rpm, above the redline of 2,700 rpm, and the airspeed needle was slightly above the maximum 210 KIAS value shown on the instrument. The fuel-flow gauge needle was found slightly loose and indicated 22 gallons per hour.

There was no evidence of any preimpact failures of the airframe, engine, flight instruments, avionics, or autopilot. The landing gear was up. Throttle and propeller controls were found full forward. Annunciator lights from the autopilot showed no evidence of filament stretching, indicating that the autopilot was not in use.

Aircraft information

The accident airplane was a Piper PA-32R-301 Saratoga II, a single-engine, low-wing airplane with retractable landing gear. The airplane was originally certificated by Piper Aircraft Corporation on June 9, 1995, and had been owned by several pilots before being sold to Kennedy on April 28, 1999. During the prepurchase inspection, "The aircraft was found to be in very good condition, with only a few minor discrepancies." An annual inspection was completed on June 18, 1999, at a total airframe time of 622.8 hours.

Meteorological information

There is a wealth of weather data and the warning, while there, is subtle. Would you have been concerned? Some information, italicized in the text and table, shows that the weather had the potential to snare a VFR pilot. Had the flight departed as originally planned, Kennedy and his passengers would have arrived well before sunset. Sunset was at about 8:14 p.m., and civil twilight ended at about 8:47. When the accident occurred about 9:40, the moon was 11.5 degrees above the horizon at a bearing of 270.5 degrees and provided about 19 percent illumination. Despite the relatively good weather report from Martha's Vineyard, several pilots reported considerable haze, which would have obscured what little moonlight there was.

According to Weather Service International (WSI), a private weather service, Kennedy — or someone using his password — made two weather requests from WSI's Web site on July 16, 1999. The first request, at 6:32 p.m., was for a radar image and the second, made at 6:34, was for a route briefing from Teterboro to Hyannis, with Martha's Vineyard as an alternate.

Pilot preflight weather requests

The 6 p.m. weather observations from several airports along the route indicated that visibilities ranged from 10 miles along the route to four miles in haze at Caldwell. The lowest cloud ceiling was reported as 20,000 feet overcast at Providence, Rhode Island. Observations for Nantucket (ACK), Hyannis, and Martha's Vineyard were also included in the briefing. At the departure point of Caldwell at 5:53, the sky was clear; visibility four miles in haze; and the winds were 230 degrees at 7 kt.

However, according to WSI, Kennedy did not access the updated National Weather Service (NWS) area forecast (FA). Excerpts from the Boston area forecast, issued on

July 16 at about 8:45 p.m. and valid until July 17 at 2 a.m., included scattered clouds at 2,000 feet, occasional visibility 3 to 5 miles in haze, with haze tops at 7,000 feet for the area including Martha's Vineyard.

The National Weather Service does not prepare aviation terminal forecasts (TAFs) for Martha's Vineyard. Excerpts from the closest TAF pertinent to the accident, issued for Nantucket on July 16 about 1:30 p.m. and valid from 2 p.m. July 16 to 2 p.m. July 17, was for clear skies, visibility greater than 6 miles, and winds from 240 degrees at 15 kt. A later forecast was not quite so optimistic. The 7:30 p.m. TAF, valid from 8 p.m. July 16 to 2 a.m. July 17, was for winds from 240 degrees at 15 kt; visibility 4 miles, mist; and scattered clouds at 25,000 feet. Temporary changes from July 16 at 9 p.m. to July 17 at 1 a.m.: clouds 500 feet scattered; visibility 2 miles, mist.

The terminal forecast for Hyannis also deteriorated; the 1:30 p.m. TAF called for clear skies and visibility greater than 6 miles, but the TAF issued at 7:30 called for winds from 230 degrees at 10 kt; visibility 6 miles, haze; and scattered clouds at 9,000 feet — with temporary changes from 8 p.m. July 16 to midnight July 17 of visibility 4 miles, haze.

There were no airmets, sigmets, convective sigmets, or in-flight weather advisories in effect along the route between Caldwell and Martha's Vineyard from 8 p.m. to 10 p.m.

Surface weather observations

Martha's Vineyard used an automated surface observing system (ASOS) that could be edited and augmented by ATC tower personnel if necessary. Despite some assertions by the tabloid press, the NTSB found no anomalies regarding the ASOS at the Vineyard. During an interview, the tower manager stated that no actions were taken regarding the ASOS during his shift, which ended just after the accident occurred. He also stated, "The visibility, present weather, and sky condition at the approximate time of the accident was probably a little better than what was being reported. I say this because I remember aircraft on visual approaches saying they had the airport in sight between 10 and 12 miles out. I do recall being able to see those aircraft and I do remember seeing the stars out that night.... To the best of my knowledge, the ASOS was working as advertised that day with no reported problems or systems log errors."

The Nantucket weather was clearly marginal for VFR operations, especially at night. The one-degree temperature/dew point spreads at Nantucket and at Hyannis show the highly variable nature of weather in the islands. Even without clouds, especially at night, haze can be a significant obscuring factor. In this microclimate, fog forms rapidly and can be localized. The Martha's Vineyard weather, taken out of context, would lead one to believe that VFR was a reasonable option.

Further evidence of that comes from some Coast Guard weather observations that would not have normally been available to pilots. At Point Judith, Rhode Island, the 5 p.m. and 8 p.m. reports were cloudy, with 3 miles' visibility in haze. By 11 p.m., however, it was cloudy with 2 miles' visibility.

Pilot observations

One pilot who flew from Teterboro to Nantucket requested current weather observations and forecasts for Nantucket and other points in Massachusetts, Connecticut, New York, and New Jersey. Visibilities were well above VFR minimums. He asked flight service "...if there were any adverse conditions for the route TEB to ACK. I was told emphatically: 'No adverse conditions. Have a great weekend.' I queried the briefer about any expected fog and was told none was expected and the conditions would remain VFR with good visibility. Again, I was reassured that tonight was not a problem."

The pilot departed Teterboro "...in daylight and good flight conditions and reasonable visibility. The horizon was not obscured by haze. I could easily pick out landmarks at least five [miles] away." Above 14,000 feet, the visibility was unrestricted. During descent to Nantucket, when GPS indicated that he was over Martha's Vineyard, he looked down and "...there was nothing to see. There was no horizon and no light.... I turned left toward Martha's Vineyard to see if it was visible but could see no lights of any kind nor any evidence of the island.... I thought the island might [have] suffered a power failure. I had no visual reference of any kind, yet was free of any clouds or fog." Upon contacting Nantucket Tower for landing, he was instructed to fly south about five miles; however, he maintained a distance of three to four miles because he could not see the island at five miles. Approaching the airport, he made a turn for spacing and "found that I could not hold altitude by outside reference...."

Another pilot flying from Bar Harbor, Maine, to Long Island, New York, crossed Long Island Sound at about 7:30 p.m. The preflight weather briefing indicated visual conditions, but the pilot filed IFR at 6,000 feet. Visibility ran two to three miles in haze throughout the flight. The lowest visibility was over water, but no clouds were encountered.

A third pilot departed Teterboro at about 8:30 p.m. destined for Martha's Vineyard. Climbing to 7,500 feet, the route took him over the north shore of Long Island. The entire flight was conducted under VFR, with a visibility of three to five miles in haze. Over land, he could see lights on the ground when looking directly down or slightly forward. Over water, there was no horizon; he encountered no cloud layers or ground fog during climb or descent. Near Gay Head, on the southwest corner of the island, he began to observe lights on Martha's Vineyard. About four miles from MVY he first observed the airport's rotating beacon and landed at about 9:45.

Another pilot at Caldwell canceled his planned flight from there to Martha's Vineyard because of the "poor" weather. "From my own judgment, visibility appeared to be approximately four miles — extremely hazy. Winds were fairly light. Based only on the current weather conditions at CDW, the fact that I could not get my friends to come with me, and the fact that I would have to spend money on a hotel room in Martha's Vineyard, I made the decision to fly my airplane to Martha's Vineyard on Saturday."

The interviewed pilots who flew that night, despite operating under VFR, were apparently experienced and qualified to fly IFR if needed. We will never know how many noninstrument-rated pilots successfully made the trip that night and how many canceled.

Pilot information

Kennedy obtained his private pilot certificate in April 1998 and received a high-performance airplane signoff in his Cessna 182 in June 1998. His complex sign-off in the accident airplane was completed in May 1999. Estimated total flight time, excluding simulator training, was about 310 hours, of which 55 hours were at night. Seventy-two hours were without a CFI on board. His estimated flight time in the accident airplane was about 36 hours, of which 9.4 hours were at night. Only about three hours of that flight time was without a CFI on board, and Kennedy had flown the aircraft by himself at night for less than an hour. In the 15 months before the accident, Kennedy had flown 35 flight legs either to or from the Essex County/Teterboro, New Jersey, and the Martha's Vineyard/Hyannis, Massachusetts, areas. At least half of these trips were without a CFI on board, and five occurred at night.

The CFI who prepared Kennedy for his private pilot checkride observed that he had "very good" flying skills for his experience level. The pilot examiner who administered the checkride said he successfully recovered from two unusual attitudes while wearing a hood. During 1998, Kennedy flew approximately 179 hours, including about 65 hours without a CFI on board. In March 1999, he passed the instrument pilot knowledge (written) examination.

In April 1999, Kennedy went to a highly respected flight academy for concentrated instrument training, where he completed about half of the course. His instrument instructor noted progression was normal and that he "grasped all of the basic skills needed to complete the course." His instrument flying skills and simulator work were observed to be excellent. However, there was trouble managing multiple tasks while flying, which the CFI felt was normal for the pilot's level of experience.

Kennedy continued to receive flight instruction in his new Saratoga from CFIs in New Jersey. On one flight from Caldwell to Martha's Vineyard with an instructor — less than a month before the accident — an instrument approach was made into Martha's Vineyard through a 300-foot overcast. The CFI requested an IFR clearance and demonstrated a coupled ILS approach to Runway 24. Kennedy performed the landing, but the CFI assisted with the rudder because of the pilot's injured ankle.

Another CFI who flew with Kennedy for 39 hours between May 1998 and July 1999 accumulated 21 hours of night flight and 0.9 hour in instrument conditions. On July 1, 1999, the CFI flew with the pilot in the Saratoga to Martha's Vineyard. The flight was conducted at night with IMC at the airport. During the flight, Kennedy used and seemed competent with the autopilot. The CFI had to taxi the airplane and assist the pilot with the landing because of Kennedy's leg injury.

The instructor stated that Kennedy had the ability to fly the airplane without a visible horizon but was not ready for an instrument evaluation as of July 1, 1999, and needed additional training. The CFI observed that he would not have felt comfortable with Kennedy conducting night flight operations on that route and in those weather conditions. On the day of the accident, the CFI offered to accompany them that night but Kennedy replied that "he wanted to do it alone."

A third CFI flew with Kennedy for nearly 60 hours between May 1998 and July 1999, including 17 hours of night flight and eight hours flown in IMC. This CFI had conducted the complex airplane sign-off in May 1999. On one or two occasions he noted a disparity in the airplane's autopilot where it turned to a heading other than the one selected, but did not feel that the problem was significant. As noted earlier, no discrepancies could be found in what was left of the autopilot.

The CFI made six or seven flights to Martha's Vineyard with Kennedy in the accident airplane. Most were night flights, and Kennedy did not have any trouble flying the airplane. He was methodical about flight planning and very cautious about his aviation decision making. The CFI felt that he had the capability to conduct a night flight to Martha's Vineyard as long as a visible horizon existed.

In early June, Kennedy fractured his left ankle in a hang-gliding accident; it was placed in a cast, and later, a walking cast. The walking cast was removed, and on July 16, 1999, the day of the accident, he was given a "straight cane and instructed in cane usage." The orthopedic surgeon felt that, at the time of the accident, the pilot would have been able to apply the type of pressure with the left foot that would normally be required by emergency brake application in an automobile.

The probable cause of the accident, according to the NTSB, was the pilot's failure to maintain control of the airplane during a descent over water at night, which was a result of spatial disorientation. Factors in the accident were haze and the dark night. The depth of the NTSB's human factors investigation in this accident is commendable, recognizing the high-profile nature of the victims. This emphasizes the need for thorough human factors data collection, especially in weather-related accidents like this. The more we can learn about a pilot's background, training, and the decision processes used, the better we are able to educate ourselves to avoid similar circumstances.

Kennedy had more than the average amount of instruction and experience for his low total number of flight hours and flew far more frequently than most noncareer pilots. He had already shown that he could control an aircraft solely by reference to instruments and had done so before under similar conditions with a CFI on board. He was conducting a flight in an area with which he was very familiar and had been successful both at night and in IMC.

Two other factors worth mentioning are Kennedy's relatively low time in the aircraft type — a common predictor in accident scenarios — and Kennedy's low pilot-in-command hours. Most of his flight time was dual. The dynamic changes when a pilot must make all the decisions on his own when he is used to having an experienced CFI call the tough ones.

The weather at the reporting points was reasonable for a day VFR flight. However, the reports must be taken in context. At night, over the water, it becomes marginal. As reported by the interviewed pilots, en route conditions were very hazy. A point that cannot be emphasized too strongly is that a pilot's decision making must be *based on what is seen (or not seen) through the windshield. It must not be based on forecasts or on observation points some 10 or 15 miles distant.* What you see is what you get! Weather forecasting is both art and science, and the weather will change — something that many pilots fail to take into account.

The flight proceeded normally until the descent, when it appears that Kennedy disengaged the autopilot. That was precisely the time, in retrospect, to leave it on. The stable platform of level flight becomes more treacherous when the aircraft is climbing or descending. The fluids in the inner ear move in multiple directions, and the final radar plot shows a classic disorientation spiral where the aircraft descended and climbed, made several turns, and then the pilot — when level — was tricked by his senses into rolling the aircraft into a gentle bank. As the nose pitched down and the airspeed increased, the pilot, sensing he was level, pulled back rather than rolling wings level. This further increased the bank angle, which caused the nose to drop farther and G forces to build. The only salvation is to believe the flight instruments and ignore your senses. It is counterintuitive and essential.

With hindsight, what should have been done differently? Obviously, complete the flight before dark, get updated forecasts, ask for (and give) pilot reports, and have an alternate plan. Kennedy had no contact with anyone after departing Caldwell. VFR traffic advisorys, frequently called *flight following,* from ATC would have been an excellent idea in the high-density traffic of the Northeast. Filing a flight plan is also recommended, but flight following could facilitate a faster search-and-rescue response if needed. It also helps to keep VFR flight separated from IFR traffic, but that is dependent on controller workload. The Golden Rule is to always have an out, an alternative for escaping a bad situation. By the time the flight was descending, the options were rapidly diminishing. The focus had shifted to landing at the destination, not diverting to an alternate, which could have easily been done as the flight started out over the water and the poor visibility became evident.

This accident is ironic in one sense that Kennedy had invested in quality training, was current, familiar with the area, and had the best equipment. The softer part of the analysis is the pilot's mindset. He was a successful entrepreneur, possibly under some business stress, pressured to make a schedule for a family activity, and must have experienced the self-imposed stress that most pilots feel to complete a trip. Couple that with his earlier successful exposure to the night/haze/IMC environment of the islands, and it seems he believed that the reward of completing the trip outweighed what seemed like a relatively low risk of spatial disorientation.

Spatial disorientation: When left is right

According to the *Aeronautical Information Manual,* illusions that lead to spatial disorientation are one of the leading factors in fatal accidents. The graveyard spiral is a likely scenario in this accident. "An observed loss of altitude during a coordinated constant-rate turn that has ceased stimulating the motion-sensing system can create the illusion of being in a descent with the wings level. The disoriented pilot will pull back on the controls, tightening the spiral and increasing the loss of altitude." Once the fluid in the semicircular canals of the inner ear has stabilized, the sensation is generally of being in level unaccelerated flight. When another control input is made, unless the pilot correctly interprets and follows the flight instruments, it is likely that the aircraft will be placed in an unusual attitude.

A very strong disorienting sensation can be induced by putting the aircraft into a prolonged constant-rate turn, allowing the sensation-sensing organs to stabilize, and then abruptly turning the head. This might occur where the pilot bends down to look at a chart, reach for something on the floor, or to change fuel tanks if the switch is poorly located. The FAA's Vertigon simulator, frequently seen at airshows, is a great place to experience this. This is not recommended for those with weak stomachs or after ingesting large quantities of greasy food. The results can be spectacular.

Obviously, if pilots maintain reference to the horizon, disorientation is not an issue. However, a benign situation can quickly deteriorate. Turn on the autopilot, if so equipped, before attempting to resolve the attitude question yourself (see "On Autopilot: Autopilot Directing"). Autopilots, even basic wing levelers, will do a far better job of keeping the aircraft upright than will a VFR pilot. Once the aircraft is stable, a 180-degree turn should return you to safe conditions. Autopilots are not intended as a substitute for the instrument rating, but they can save lives in critical situations. VFR pilots who check out in autopilot-equipped aircraft should be proficient in the autopilot's use. — *BL*

See also the index of "Safety Pilot" articles, organized by subject. Bruce Landsberg is executive director of the AOPA Air Safety Foundation.

Features

The After-Hours Club

Nighttime might account for 50 percent of a 24-hour day, on average, but the FAA-mandated night flying instructional requirement makes up only 7.5 percent of the total curriculum for the private pilot certificate. That comes out to three hours of required night flying experience within a 40-hour minimum training schedule - which hardly seems sufficient when you consider the differences between day and night flying. However, the FAA recently added the requirement under FAR Part 61.109 to perform a dual night cross-country flight of at least 100 nautical miles for private pilot candidates. The requirement for three hours of dual night flying, including 10 takeoffs and 10 full-stop landings, remains unchanged.

Once you have earned your private pilot certificate you will have to maintain or regain night flying currency if you want to carry passengers outside of daylight hours. More important than being legally current to fly at night is being safe and competent to fly at night. There are no specific federal requirements that pilots review airport lighting or common traffic advisory frequencies (CTAF); know how to determine control tower hours of operation or pilot controlled lighting (PCL) technique; or understand airport lighting or sectional chart symbology that applies to night flying - unless you consider the "preflight action" directive of FAR 91.103 as sufficient to cover "all available information concerning that flight."

Night flying simultaneously presents pilots greater challenges and offers them greater freedoms than flying during daylight hours. There is a peaceful serenity that only a calm, moonlit night can provide. There are fewer aircraft to crowd the taxiway, runway, and your route of flight. The few aircraft that you encounter are much easier to see at night because their lights are often quite visible against the dark sky (although the same can't be said if you're looking down on traffic flying over a metropolitan area). Air traffic controllers are almost always less stressed during hours of darkness because they're handling fewer aircraft, and they tend to be more relaxed and friendly.

The same city buildings that would inconspicuously blend into each other and the landscape during daylight are bristling with lights and discernable from 30 miles away at night. The airport environment looks different, too - rotating beacons, runway lighting, visual approach slope indicators, precision approach path indicators, and approach light systems all reveal your landing destination from much farther away and much more easily at night than during day - assuming the visibility is high enough. Even the radio reception range for the automatic terminal information service (ATIS), control tower, automated surface observation system (ASOS), automated weather observation system (AWOS), and flight service stations is greater at night.

There is a flip side to all of this good news, however. Consult FAR 91.155 for the different VFR visibility and cloud clearance requirements in uncontrolled airspace at night - these values change at altitudes below 10,000 feet msl. Mountains, hills, cliffs, and other natural inclines can seem to disappear if there are no lighted towers, homes, or buildings on them or any urban or natural (moonlight, for example) lighting behind them. Fog, smog, haze, smoke, and clouds - all easy to see at 10 a.m. - are invisible at 10 p.m. Even when clouds and smoke are hovering right over urban lights they appear as empty black holes and are easily mistaken for water, or more likely not noticed at all. If you expect to see a town and it is under cloud cover, for all practical purposes, it will not exist. This can lead to disaster when navigating en route at night. The lack of a horizon can be a serious concern for pilots with little night experience, particularly if flying over water. The lights from stars and vessels can quickly blend into a seamless wall of white-speckled blackness, easily leading to spatial disorientation.

Airports themselves can actually cause confusion and situational second-guessing because they are often lost among surrounding city lights. Many airports with multiple or parallel runway layouts only light one of their runways at night. Observing a single runway where you believe crossing or parallel runways should be can cause you to believe that you are not flying above the airport you expected to be near. Sometimes the airport isn't there at all! Well, it really is, but it is hidden in the darkness because all of its runway and taxiway lights are off. These factors, along with the distraction of other lighting in the area, can convince you that you are not where you think you are. Suddenly the benefits of your careful flight planning and skillful navigation can diminish into confusion and doubt.

Even if your night navigation proves to be sound, once you arrive at your destination airport there may be no weather and airport information available; the control tower may be closed; and the runway and taxiway lights may not be on. Night-only noise abatement procedures and unusual night-only arrival (and departure) routes - both unknown to you and mandated - may be in effect. The lack of current local altimeter information, especially if you are flying through an area of varying temperature and/or different barometric pressures, can leave your aircraft much higher or lower than the altitude that your altimeter is displaying. Needless to say, this situation can lead to trouble If you have difficulty seeing the airport's windsock from above in the dark (its light is rarely effective from any distance) you may inadvertently land with a tailwind. Once you are on the ground, you might not be able to buy fuel or find a telephone. These very real concerns make night flying a serious and sometimes misunderstood aspect of aviation.

Some pilots avoid night flying as much as possibly because they believe it to be too complicated or even dangerous. Of course, as in any aviation operation, knowledge and training will provide the tools needed.

Federal Aviation Regulation 61.57 provides pilots with the recency of experience requirements to fly at night. Certificated pilots may make night flights without passengers (provided that their flight review is current), but to carry passengers they must have performed a minimum of three takeoffs and three landings to a full stop from an airport traffic pattern within the last 90 days in an aircraft of the same category (airplane, helicopter, airship, glider, etc.) and class (airplane single-engine land, airplane single-engine sea, airplane multiengine land, etc.) "during the period beginning one hour after sunset and ending one hour before sunrise." Student pilots require a special endorsement to fly solo at night. Your aircraft, as per FAR 91.209, must display working position lights (also called navigation or nav lights), which consist of a green light on the right wing tip, a red light on the left wing tip, and a white light at the rear of the aircraft. You should use anticollision lights if your aircraft has them, although many pilots turn them off on the ramp, as they can be annoying to other aircraft, vehicles, and people in the vicinity. Strobe lights also should be turned off in clouds when you are flying on an instrument flight plan at night because they create a confusing illusion - fun at a disco, but horribly distracting and potentially vertigo-producing when shooting an instrument ap- proach to minimums. Landing lights are not required if the flight is not carrying paying passengers, although they, along with taxi lights, are very effective for taxiing, taking off, and landing safely at night.

Once you have ensured that pilot and aircraft are in compliance with the FARs you should become familiar with night/light symbology and entries on VFR aeronautical charts, as well as all of the useful night flying information available in the *Aeronautical Information Manual* (AIM) and *Airport/ Facility Directory* (A/FD). The AIM thoroughly explains the big picture regarding airport lighting and symbology - see: "Aero lighting/Visual aids." The A/FD (or its commercial equivalent airport guide) will be a necessary tool for obtaining specific airport lighting, runway, radio frequency, control tower operating hours, pilot controlled lighting (PCL) frequencies and mic keying requirements, runway end identifier lights (REIL) availability, and other necessary information via its coded entries (there is a key in the front of the book).

The VFR sectional and terminal charts' airport data lines and airport depictions include coded information and symbols that pilots must understand for night flight planning. The solid blue star (after the CT - control tower - frequency) at towered airports indicates that the control tower is not in full-time operation (the hours of operation for each airport depicted on a particular chart can be obtained by unfolding the chart and looking up the frequencies tabulation).

The letter "C" enclosed in a solid blue circle after the CT frequency and solid star means the airport has a common traffic advisory frequency, or CTAF. This frequency is used when the tower is not in operation or where depicted at a nontowered airport (in magenta). The next line below begins with a bolder number denoting the highest point on the runway landing surface. Then comes the runway length (in hundreds of feet - add two zeros) of the longest available landing surface. If a capital letter "L" precedes the runway length information it tells pilots that the runways are lighted during times of darkness.

An "L" preceded by a small asterisk indicates that pilot-controlled lighting is in use at the field - the lights don't come on until the pilot activates them. The pilot keys the radio's microphone, and the approach (if available), runway, taxiway (if available), and ramp (if available) lighting comes on for a period of 15 minutes. Although not generically published as such, the PCL frequency is almost always the same as the CTAF (or unicom). You will still need to confirm the proper frequency in the A/FD, as well as the proper number of "clicks" of the microphone for various levels of approach and runway lighting.

Civil airports are identifiable at night (and during the day if the weather is below basic VFR) by their rotating beacon - one green flash, one white flash (military airports flash two white for each green). Taxiway edge lights are blue (taxiway "lead off" lines - from the runway center line to the taxiway center line - are green and yellow, while taxiway centerline lights are green). Runway edge lights are white (except on instrument runways where they change from white to amber the last 2,000 feet).

At larger airports you may encounter touchdown zone lighting on either side of the runway centerline ending 3,000 feet down the runway, and runway centerline lights, which are white until between 3,000 feet and 1,000 feet of remaining runway, where they alternate red and white until the final 1,000 feet, where they are all red. Runway threshold lights mark the beginning and end of the runway. They appear green flying toward the approach end of the runway and red toward the departure end of the runway. Displaced threshold lights are outboard from the beginning of available landing area. Runway end identifier lights (REIL) are a pair of bright synchronized flashing lights on each side of the runway threshold. They are there to make the runway more conspicuous among surrounding lighting.

When control towers shut down for the night these airports become nontowered fields, and pilots should employ all of the radio transmissions and safety precautions used at other nontowered airports.

With a well-prepared plan of action; knowledge of the FARs, AIM entries, sectional chart symbology, aviation lighting, and A/FD information pertaining to night flying; as well as a carefully detailed strategy for each specific night flight; you will soon learn that flying outside of daylight hours can provide some of the most enjoyable and memorable of your aviation adventures.

10 Night Flying Tips

1. Consult and comply with federal aviation regulations pertaining to night flying (FAR 61.57, 91.155, and 91.209).
2. Airport control tower hours of operation can be obtained from VFR charts, the

Airport/Facility Directory, commercially produced airport guides such as *AOPA's Airport Directory*, ATIS (when the tower is closed), and via radio from Flight Service (122.2 MHz).

3. During preflight inspection ensure that all lighting - position lights, rotating beacon, interior and instrument lighting, landing/taxi lights, and extra lighting such as anticollision lights - is functioning properly.
4. Choose alternate airports along the planned route of flight and note all runway and traffic pattern information and frequencies. What would you do if you arrived at your destination airport and a plane ahead of you lands gear-up, causing the closure of the only runway? Have a back-up plan.
5. Always file (and open and close) a flight plan with Flight Service and use radar flight following (from a nearby towered airport, approach controller, or air route traffic control center) at night.
6. On your downwind leg, "click on" pilot-controlled lighting again to ensure airport lighting won't go out when you need it most.
7. Adhere to the "15 minute rule." Use a flashlight to check the heading indicator against the magnetic compass every 15 minutes. Also, make sure you are on course at least as often.
8. Make sure you are familiar with radio failure procedures and transponder code (7600), and light gun signals (FAR 91.125).
9. Practice above and beyond the minimum number of night takeoffs and landings (three landings to a full stop every 90 days) for safety and proficiency and not just to satisfy the regulations. (Some pilots occasionally practice night landings with the landing light off and flaps up to ensure proficiency with an electrical/light failure.)
10. Bring a flashlight (red light if available) and test that batteries are fully charged before you start your preflight inspection. Back-up flashlights should be within easy reach in the cockpit as you fly in the event your panel lighting fails.

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