II.H. Night Operations

References: FAA-H-8083-3; FAA-8083-3-25; AIM

Objectives
The student should develop knowledge of the elements related night operations.
The student will understand the unique factors that are inherent to night flight.

Key Elements
1. Off Center Viewing
2. Instrument Indications
3. Maintain Orientation

Elements
1. How The Eyes Work
2. Disorientation and Night Optical Illusions
3. Pilot Equipment
4. Preflight
5. Engine Starting
6. Taxiing, Airport Orientation, and The Runup
7. Takeoff and Climb
8. In-Flight Orientation
9. Traffic Patterns
10. Approach and Landing
11. Go Arounds
12. Night Emergencies

Schedule
1. Discuss Objectives
2. Review material
3. Development
4. Conclusion

Equipment
1. White board and markers
2. References

IP’s Actions
1. Discuss lesson objectives
2. Present Lecture
3. Ask and Answer Questions
4. Assign homework

SP’s Actions
1. Participate in discussion
2. Take notes
3. Ask and respond to questions

Completion Standards
The student is comfortable in his understanding of the factors involved in night operations and can confidently and safely pilot an aircraft at night.
Instructors Notes:

Introduction:

Attention
A lot of people tend to find night flight very enjoyable...

Overview
Review Objectives and Elements/Key ideas

What
Night operations are the factors dealing with and the operation of the airplane at night.

Why
It is important to talk about night flight as it presents many unique situations which, if ignored, can result in dangerous situations. Also, if you learn to use your eyes correctly and know your limitations, night vision can be improved significantly.

How:
1. How the Eyes Work
   A. Rods and Cones
      i. Two types of light sensitive nerve endings which transmit messages to the brain via the optic nerve
         a. Cones - Responsible for color, detail, and far away objects
            • The cones are located in the center of the retina
         b. Rods – Function when something is seen in the peripherals and provide vision in dim light
            • The rods are located in a ring around the cones
      ii. Both the cones and rods are used for vision in the day
         a. But, without normal light, the process of night vision is placed almost entirely on the Rods
      iii. Rods, Cones, and Night Vision
         a. Cones are located in the center of the retina (the layer upon which all images are focused)
            • There is a small pit called the fovea where almost all the light sensing cells are cones
               a. This is the area where most looking occurs
         b. The Rods
            • Make night vision possible
            • During daylight, objects can be seen by looking directly at them, but at night a scanning procedure to permit off center viewing is more effective
            • Rods are located are concentrated in a ring around the cones
               a. In low light, the middle field of vision isn’t very sensitive, there is a “night blind spot”
               b. Farther from the fovea, the rods are more numerous and are used to see in dim light
               c. Since Rods don’t lie directly behind the pupils, off-center viewing is used for night flight
            • The problem with Rods is that a large amount of light overwhelms them and they take a long time to reset and adapt to the dark again
               a. The rods can take approx 30 minutes to fully adapt to the dark
                  1. Once fully adapted the Rods are about 100,000x more sensitive to light
                  2. EX: Walking into a movie theatre
               b. After the rods have adapted to the dark, the process is reversed when exposed to light
                  1. Their eyes adjust to the light in a matter of seconds to the light
                  2. If the dark room is reentered, the 30 min process to adapt is started again
a. Therefore, it is important to avoid bright lights before and during a flight

iv. Summary
   a. Night vision is based on the rods and off center viewing is necessary since they are located
      around the center of vision
   b. It is important to avoid bright lights before and during a flight to maintain adequate night vision

B. Cockpit Lighting
   i. Cockpit lighting should be at a minimum brightness that will allow reading of the instruments and
      switches without hindering outside vision

2. Disorientation and Night Optical Illusions
   A. In addition to night vision limitations, be aware that night illusions can cause confusion
   B. Autokinesis
      i. Caused by staring at a single point of light against a dark background for over a few seconds
      ii. The light appears to move on its own
      iii. Prevent by focusing the eyes on objects at varying distances and avoid fixating
   C. False Horizon
      i. Caused when the natural horizon is obscured/not readily apparent
         a. Generated by confusing bright stars and city lights
   D. Featureless Terrain
      i. An absence of ground features can create the illusion that the aircraft is higher than it actually is
      ii. Resulting in a tendency to fly a lower than normal approach
   E. Runway Slopes
      i. An upsloping runway/terrain can create the illusion that the aircraft is higher than it actually is
         a. The pilot who does not recognize this will fly a lower approach
      ii. Downslope – The opposite applies
   F. Ground Lighting
      i. Regularly spaced lights along a road/highway/etc can appear to be runway lights
      ii. Lights on moving trains have been mistaken for runway/approach lights
      iii. Bright runway or approach lights can create the illusion the airplane is closer to the runway
   G. Verify Attitude by Reference to the Flight Instruments
      i. Reference to the flight instruments is the best way to cope with disorientation/optical illusions
         a. If making an approach and an ILS or VASI is available make use of it
      ii. Visual references are limited – you will need to use more instruments (don’t be dependent on them)
      iii. If at any time the pilot is unsure of their position, a go around should be executed

3. Pilot Equipment
   A. Flashlight
      i. Red or white light
         a. White light is used to preflight the aircraft
         b. Red light is used when performing cockpit operations as it will not impair night vision
            • When using a red light on an aeronautical chart, the red colors will wash out
   B. Aeronautical Charts
      i. If the intended course of flight is near the edge of a chart, the adjacent chart should be available
         a. City lights can be seen at far distances and confusion can result without the necessary charts
   C. Regardless of equipment, organization eases the burden on the pilot

4. Preflight Inspection (FAR 91.205)
   A. Required equipment for VFR flight at night
      i. TOMATO FFLAMES and FLAPS
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a. Fuses
b. Landing Light
c. Anti Collision Lights
d. Position Lights
e. Source of Power

ii. Instrument required equipment doesn’t hurt

B. Walk Around
   i. Preflight inspection is still necessary
   ii. White light flashlight is good
   iii. Check all aircraft lights
   iv. Check the ramp for obstructions

5. Engine Starting
   A. Be very sure the propeller area is clear
      i. Turn on position and anti-collision lights prior to start
      ii. Announce “Clear Prop”
   B. Keep all unnecessary electrical equipment off to avoid draining the battery

6. Taxiing, Airport Orientation, and the Runup
   A. Taxing
      i. Due to restricted vision, taxi speeds should be reduced
         a. Don’t taxi faster than a speed that will allow a stop within the distance you can clearly see
      ii. Use the landing/taxi lights as necessary – Caution overheating (no airflow)
      iii. Do not use strobes/landing lights in vicinity of other aircraft
         a. Can be distracting/blinding
   B. Orientation
      i. Airport Diagram
      ii. Understanding taxiway markings, lights, and signs
   C. The Runup
      i. The before taxi runup should be performed with the checklist as usual
      ii. Forward movement of the airplane may not be easy to detect
         a. Hold/lock the brakes and be alert that the airplane could creep forward without being noticed

7. Takeoff and Climb
   A. Clear the area for approaching traffic – Final Approach
      i. Uncontrolled airports: Make a 360° turn in the direction of air traffic to clear
   B. After receiving clearance, align the airplane with the centerline
      i. Check to ensure the MC and HI match the runway intended
   C. Perform a normal takeoff depending more on the instruments as many visual cues are not available
      i. Perception of runway width, airplane speed, and flight attitude will vary at night
         a. The flight instruments should be checked frequently
      ii. As the AS reaches $V_{le}$, the pitch attitude should be adjusted to establish a normal climb
         a. Refer to outside visual references (such as lights) and the flight instruments
   D. Climb
      i. To ensure the airplane is climbing check the AI, VSI and Altimeter; the darkness makes it hard to tell
      ii. Necessary adjustments should be made by referencing the attitude and heading indicators
         a. Recommended that turns not be made until reaching a safe maneuvering altitude

8. In-Flight Orientation
   A. Checkpoints – Although there are less of them, it does not pose a problem
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i. Light patterns of towns are easily identified
ii. Rotating beacons are useful
iii. Highways
iv. Ensure you maintain orientation as it is easier to become disoriented in relation to location
   a. Continuously monitor position, time estimates, and fuel consumed
v. NAVAIDS should be used whenever possible

B. Clouds/Restricted Visibility
i. It is difficult to see clouds – exercise caution to avoid flying into MVFR/IFR weather conditions
   a. 1st indication - Gradual disappearance of the ground and glowing around lights

C. Nav Lights
i. Red Light on Left Wing/Green Light on Right Wing and White Light on the Tail
   a. Use to orient another aircraft's direction in relation to your own

9. Traffic Patterns
A. Identify runway/airport lights as soon as possible
   i. May be difficult to find the airport or runways
      a. Fly towards the beacon until you identify runway lights
      b. Compare the runway lights with HI to ensure you are in the right place
B. Distance may be deceptive at night due to limited light conditions
   i. A lack of references on the ground and the inability to compare their location and size cause this
   ii. More dependence must be put on the instruments (particularly the Altimeter and ASI)
C. Landing light should be on for collision avoidance
D. Fly a normal traffic pattern
   i. Know the location of the runway/approach threshold lights at all times
      a. Execute the approach in the same manner as during the day

10. Approach and Landing
A. A stabilized approach should be made in the same manner as during the day
B. Use flight instruments more often (especially altimeter/ASI)
   i. Distance, etc may be deceptive
   ii. Maintain specified airspeeds on each leg and watch VSI to keep the approach under control
C. Final Approach
   i. If there are no centerline lights, align the airplane between the edge lights
      a. Note and correct any wind drift
   ii. Power and pitch corrections to maintain a stabilized approach
      a. Use approach lights (VASI, PAPI, etc) to maintain glideslope
D. Roundout/Touchdown
   i. A smooth, controlled roundout and touchdown should be made in the same manner as in the day
      a. Judgment of height, speed, and sink rate may be impaired
         • There may be a tendency to round out too high
   ii. Start the roundout when the landing lights reflects on the tire marks on the runway
      a. In the case you have no landing light/can't see tire marks start the roundout when the runway lights at the far end appear to be rising higher than the airplane
      b. More of a feel for the airplane in this situation

11. Go Arounds
A. Prompt decision is even more necessary at night due to the restricted visibility
   i. Be prepared in case the maneuver is necessary
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A. Electrical
   i. The greatest electrical load is placed on the system at night = the greatest chance of failure
   ii. In the case of a suspected problem
      a. Reduce load as much as feasible
      b. If total failure is expected, land at the nearest airport immediately

B. Engine
   i. Don’t Panic - Establish a normal glide and turn toward an airport or away from congested areas
   ii. Check to determine the cause and correct immediately if possible (Engine restart checklist)
   iii. If no restart – Maintain positive control of the airplane at all times!
      a. Maintain orientation with the wind – don’t land downwind
      b. Check the landing lights and use them on landing if they work
   iv. Announce the emergency to ATC or UNICOM (If on a frequency, don’t change unless instructed to)
   v. Consider an emergency landing area close to public access
      a. Before landing checklist
      b. Touchdown at the slowest possible AS
   vi. After landing, turn off all switches and evacuate as quickly as possible

Conclusion:
Brief review of the main points
Night operations present unique situations to a pilot and require diligence to maintain orientation and safety. Night flying is not inherently dangerous but it can require more effort. Overall, though, it is very enjoyable.

PTS Requirements:
To determine that the applicant exhibits instructional knowledge of the elements of night operations by describing:
1. Factors related to night vision.
2. Disorientation and night optical illusions.
3. Proper adjustment of interior lights.
4. Importance of having a flashlight with a red lens.
5. Night preflight inspection.
6. Engine starting procedures, including use of position and anticollision lights prior to start.
7. Taxiing and orientation on an airport.
8. Takeoff and climb-out.
9. In-flight orientation.
10. Importance of verifying the airplane’s attitude by reference to flight instruments.
12. Traffic patterns.
13. Approaches and landings with and without landing lights.
The rods and cones (film) of the retina are the receptors which record the image and transmit it through the optic nerve to the brain for interpretation.

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

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