Flying Samaritans® International

Pilot Guide

Recommendations For Enhanced Safety And Best Practices

Contents

Welcome to The Flying Samaritans.

Thank you for offering your services as a volunteer pilot to the Flying Samaritans, a non-profit [501(c)(3)] organization with over 1500 members, spread over 10 chapters, serving 19 clinics.

The Flying Samaritans are pilots, physicians, nurses, translators and many other professionals from different walks of life, who volunteer their time and services to help provide free healthcare and education to the underserved people in remote areas of Baja California, who otherwise have no access to medical care.

The mission of the volunteer pilot is to provide safe and reliable transportation for the medical volunteers and to support and promote the mission of the Flying Samaritans.

Introduction

The National Transportation Safety Board (NTSB) has made several flight safety recommendations to the Air Care Alliance (ACA), a group that promotes, supports and represents Volunteer Pilot Organizations (VPO) who provide public benefit flying. Among the recommendations is a requirement to develop, disseminate and require VPO's to implement written safety guidance, best practices and training material for volunteer pilots who operate charitable flights under 14 CFR 91. The NTSB stated that at a minimum the information should include, aeronautical decision-making; proper flight planing; pilot qualification, training and currency; and self-induced pressure.

The ACA embarked on a project with the Aircraft Owners and Pilots Association (AOPA), and through collaboration with the AOPA Air Safety Foundation Institute, they produced the "Volunteer Pilots Recommendations for Enhanced Safety".

Links to the NTSB, ACA and the AOPA recommendations can be found here:

http://www.aircareall.org/docs/NTSB-ACA%20SafetyRecommendationLetter-100609.pdf
http://www.aircareall.org/docs/ACA-VPOs-Recommendations-NTSB-100907.pdf
http://www.aircareall.org/docs/ASF-guide-volunteer.pdf

The Flying Samaritans strongly recommends that volunteer pilots review the AOPA Recommendations for Enhanced Safety.

Safety Guidance and Best Practices

"The price of safety is constant vigilance. Accidents are the result of several factors that culminate in an unfortunate event. Pilots who incorporate Safety Recommendations into their flight plans can minimize the likelihood of allowing an accident chain to develop." AOPA.

The Flying Samaritans have produced this pilots guide to address the flight safety concerns of the NTSB for VPO's. It is based on the recommendations of the ACA and AOPA. It includes guidance on safety and best practices, covering volunteer pilot qualification, currency and training, weather and pilot operational decision making. Included is a discussion of aeronautical decision making, the 3P decision making model, an introduction to risk assessment through the PAVE checklist, the establishment of personal minimums and the use of pulse oximetry.

The intent of this guide is to provide a set of recommendations through which individual volunteer pilots can improve their levels of performance and the safety of their flying. It presents suggestions and best practices to be used in enabling volunteer pilots to provide a safer service to their passengers. Although these best practices are suggestions and not mandatory, there are regulatory requirements that must be met in order to provide volunteer pilot services for Flying Samaritan missions.

- All volunteer flights are to be conducted under FAR Part 91, General Operating and Flight Rules.

- All volunteer pilots must comply with FAR Part 61 currency requirements prior to carrying passengers when operating under VFR and/or IFR. It should be stressed that these are minimum requirements, and by developing higher personal standards and good operating practices, volunteer pilots can strive for a high level of safety and service. It is recommended that volunteer pilots obtain annual recurrent training, which may include flight training, attendance at seminars or the use of web based training materials.

- All volunteer pilots will meet or exceed performance levels cited in the Federal Aviation Administration (FAA) Practical Test Standards appropriate to their certificates and ratings.

- All volunteer pilots are to annually self-certify to their chapter pilot coordinator, that they meet all applicable requirements of the FAR's to include currency requirements and that they will maintain their currency before accepting any volunteer flight.

- Only aircraft with a U.S. issued Airworthiness Certificate in the Normal or Utility Category may be used for Volunteer flights.

- By providing this guide, the Flying Samaritans is not exercising any operational control over pilots who provide their services voluntarily. The Flying Samaritans does not own, rent or operate any aircraft. The Flying Samaritans does not operate a flight department or hold an FAA Operating Certificate. No offer of employment or compensation for hire is offered or implied. The Flying Samaritans is not a regulatory agency and cannot actively censure, prohibit, restrict, fine, or otherwise impact a pilot's right to fly. This guide is not intended to duplicate or take precedence over any Federal Aviation Regulation.

- Volunteer flights are operated by the Pilot in Command (PIC) under FAR Part 91 and the PIC maintains operational control of the flight and makes all decisions pertaining thereto. Volunteer pilots are to adhere to all applicable laws and regulations, to include the Federal Aviation Regulations, the Aeronautical Information Manual as well as US Immigration and Customs policies and procedures. Volunteer pilots who offer their services and aircraft, do so at their own risk.

- If pilots are not able to operate in accordance with these recommendations and best practices, the pilot is requested to make a report of the circumstances to their chapter pilot coordinator.

These recommendations do not take precedence over PIC emergency authority or common sense.

Pilot Recommendations

Based on the AOPA Air Safety Foundation 'Recommendations for Enhanced Safety'.

Experience and Qualifications:

- A FAA issued Private Pilots License or higher rating.
- 200 hours PIC (50 hours PIC to act as co-pilot).
- 30 hours PIC in type.
- A local flight check conducted by a Chapter approved CFI.
- A pilots initial flight into Mexico will be in the company of a Chapter approved pilot.

Currency and Training:

- One cross-country within previous 60 days.
- 3 hours of flight time in the same category and type in the past 3 months.
- Annual flight review.
- Annual self certification of currency and training.

Duty Times:

Duty time is defined as all flight related activities, preflight to tie-down.

- 8 hours - Maximum flying per day.
- 10 hours - Rest time between duty periods.
- 12 hours - Total business + personal activities + flying duties.
- 16 hours - Total duty day (waking hours).

Weather Recommendations

One of the most important concepts that safe pilots understand is the difference between what is "legal" in terms of the regulations, and what is "smart" or "safe" in terms of pilot experience and proficiency.

Basic weather minimums are described in FAR 91, Subpart B. These are minimum safe operating values and do not prevent a pilot from adopting higher personal minimums.

VFR Day:

- 3 hours PIC within 30 days.
- 1 landing within 30 days.
- 2,000-foot ceiling 5 miles visibility (higher in mountainous terrain).
- Special VFR is not recommended.

VFR Night: (in addition to the above)

- 15 night hours PIC.
- 1 night hour and 1night landing within 30 days.
- 2,000-foot ceiling 5 miles visibility (higher in mountainous terrain).
- CAUTION – Except for a few very limited exceptions related to boarder crossing, there are NO night VFR flights in Mexico.

IFR Day:

- 25 hours instrument PIC with 5 hours actual IMC after instrument certification.
- 1 IFR cross-country within 30 days.
- Departure minimums equal to approach minimums for safe return.
- Approach minimums of 400' / 1sm or lowest minimums plus 200' / ½sm.
- Circling approaches not recommended unless the ceiling and visibility are greater than 1000' / 3sm.
- NDB approach not recommended.

IFR Night: (in addition to the above)

- 10 hours night instrument PIC in addition to day IFR recommendation.
- 1 night hour and 1 instrument approach within 30 days.
- 1 IFR cross-country within 60 days.
- Approach minimums of 400' / 1sm or lowest minimums plus 200' / ½sm.
- Weather at or above recommended landing minimums (400' / 1sm) to initiate the approach.
- Circling approaches not recommended.
- NDB approach not recommended.
- Night IFR in Mexico is not recommended.

Wind:

- Crosswind: 75 percent of aircraft limit.
- Headwind: 50 percent of aircraft stall speed.

Severe Weather:

• Maintain a distance of at least 20 miles from thunderstorms.
• No flight in sustained moderate or greater turbulence.
• No flight in freezing rain.
• Avoid flight in icing conditions unless aircraft is approved by type certificate.

Mountains:

• 5,000-foot ceiling / 10 miles visibility for all phases of flight.

Operational Recommendations

Airworthiness:

The pilot in command is responsible for determining whether an aircraft is in airworthy condition for safe flight.

- A preflight of the aircraft in accordance with the manufactures POH.
- Inspected in accordance with Subpart E of FAR Part 91.
- All airworthiness directives complied with.
- All installed equipment must be operative in accordance with FAR Part 91.213(d).
- The aircraft conforms to the FAA-approved type design.
- Transponder tested within the preceding 24 months.
- Most current GPS database installed (if applicable).
- If IFR flight is contemplated, an altimeter-static system inspection within the preceding 24 months and VOR/GPS equipment checks complied with.

Planning:

- File a FAA flight plan appropriate for the type of flight being conducted.
- Use radar flight following if available.
- Minimum VFR enroute altitude of 1,500' AGL. Higher for obstacles, terrain, and congested areas.
- Flights over water outside of gliding distance to land (except for takeoff and landing) require personal floatation device to be carried.
- The carriage of a survival kit is recommended.
- Oxygen use - in accordance with FARs.
- Fuel Reserves - 1 hour for VFR flights and 1 1/2 hour for IFR flights.

Performance:

- Weight and balance is to be calculated for all flights in accordance with aircraft POH.
- Takeoff and landing performance is to be calculated for all flights in accordance with aircraft POH.
- Hard surface runways are recommended that are 50% longer than the required takeoff and landing distances.

Checklist Usage:

- An aircraft operating checklist is recommended to be available and used for all flight operations.

Manipulation of Controls:

- Except in case of emergency, only fully qualified pilots in make and model will make takeoffs, landings, and operate the aircraft in critical phases of flight.
- It is recommended that the most qualified (flying experience) passenger sit in the co-pilot seat.

Pilot Self Assessment:

It is recommended that volunteer pilots make a self assessment using the IMSAFE checklist, before undertaking any flight operations.

I - Illness
M - Medication
S - Stress
A - Alcohol
F - Fatigue
E - Emotional

Passenger **Safety** Briefing:

To include a summary of the planned flight time, altitude and route to be flown and expected weather conditions enroute;

S – Seatbelt and Shoulder Harness operation and usage
Seat operation and position locked
A – Air vents and Environmental controls
Airsickness and passenger discomfort
F – Fire Extinguisher location and usage
No Smoking Policy
E – Exit operation and Emergency Evacuation
Emergency equipment location and usage
T – Traffic spotting
Talking and sterile cockpit
Y – Your questions?

Safety Always Takes Priority.

Aeronautical Decision Making Process (ADM)

The following is an introduction to ADM and is not intended to be a complete discussion of ADM topics. Pilots are strongly encouraged to review the material provided by the FAA at the following links and to incorporate ADM into their recurrent training.

FAA Advisory Circular AC 60-22 Aeronautical Decision Making
http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_60-22.pdf

FAA Pilots Handbook of Aeronautical Knowledge, Chapter 17
http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/media/phak%20-%20chapter%2017.pdf

ADM is a systematic approach to the mental process used by pilots to consistently determine the best course of action in response to a given set of circumstances. It is what a pilot intends to do based on the latest information he or she has.

Despite all the changes in technology to improve flight safety, one factor remains the same: the human factor which leads to errors. It is estimated that approximately 80 percent of all aviation accidents are related to human factors and the vast majority of these accidents occur during landing (24.1 percent) and takeoff (23.4 percent).

Two defining elements of ADM are hazard and risk. Hazard is a real or perceived condition, event, or circumstance that a pilot encounters. When faced with a hazard, the pilot makes an assessment of that hazard based upon various factors. The pilot assigns a value to the potential impact of the hazard, which qualifies the pilot's assessment of the hazard—risk. Therefore, risk is an assessment of the single or cumulative hazard facing a pilot. When a pilot follows good decision-making practices, the inherent risk in a flight is reduced or even eliminated.

Risk assessment is only part of the equation. After determining the level of risk, the pilot needs to mitigate the risk. One of the best ways single pilots can mitigate risk is to perceive hazards by incorporating the PAVE checklist into preflight planning. With the PAVE checklist, pilots have a simple way to remember each category to examine for risk prior to each flight. Once a pilot identifies the risks of a flight, he or she needs to decide whether the risk or combination of risks can be managed safely and successfully. If not, make the decision to cancel the flight. If the pilot decides to continue with the flight, he or she should develop strategies to mitigate the risks. One way a pilot can control the risks is to set personal minimums for items in each risk category. These are limits unique to that individual pilot's current level of experience and proficiency.

One of the most important concepts that safe pilots understand is the difference between what is "legal" in terms of the regulations, and what is "smart" or "safe" in terms of pilot experience and proficiency.

The 3P MODEL: Perceive, Process, Perform

The 3P model for ADM offers a simple, practical, and systematic approach that can be used during all phases of flight. To use it, the pilot will:
- Perceive the given set of circumstances for a flight using the PAVE checklist.
- Process by evaluating their impact on flight safety using the CARE checklist.
- Perform by implementing the best course of action using theTEAM checklist.

In the first step, the goal is to develop situational awareness by perceiving hazards, which are present events, objects, or circumstances that could contribute to an undesired future event. In this step, the pilot will systematically identify and list hazards associated with all aspects of the flight:
Pilot, **A**ircraft, en**V**iroment and **E**xternal pressures. (PAVE)

In the second step, the goal is to process this information to determine whether the identified hazards constitute risk, which is defined as the future impact of a hazard that is not controlled or eliminated. The degree of risk posed by a given hazard can be measured in terms of exposure (number of people or resources affected), severity (extent of possible loss), and probability (the likelihood that a hazard will cause a loss). The pilot can process identified hazards by considering the:
Consequences, **A**lternatives, **R**eality and **E**xternal factors. (CARE)

In the third step, the goal is to perform by taking action to eliminate hazards or mitigate risk, and then continuously evaluate the outcome of this action. The pilot can manage identified risks by deciding to:
Transfer the risk, **E**liminate the risk, **A**ccept the risk or **M**itigate the risk. (TEAM)

Once the pilot has completed the 3P decision process and selected a course of action, the process begins anew because now the set of circumstances brought about by the course of action requires analysis. The decision-making process is a continuous loop of perceiving, processing and performing. With practice and consistent use, running through the 3P cycle can become a habit that is as smooth, continuous, and automatic as a well-honed instrument scan.

The PAVE Check List

P = Pilot in Command (PIC)

The pilot is one of the risk factors in a flight. The pilot must ask, “Am I ready for this trip?” in terms of experience, recency, currency, physical and emotional condition. The IMSAFE checklist provides the answers.

I Illness
M Medication
S Stress
A Alcohol
F Fatigue
E Emotional

A = Aircraft

What limitations will the aircraft impose upon the trip? Ask the following questions:
- Is this the right aircraft for the flight?
- Am I familiar with and current in this aircraft? Aircraft performance figures and the AFM are based on a brand new aircraft flown by a professional test pilot. Keep that in mind while assessing personal and aircraft performance.
- Is this aircraft equipped for the flight? Instruments? Lights? Navigation and communication equipment adequate?
- Can this aircraft use the runways available for the trip with an adequate margin of safety under the conditions to be flown?
- Can this aircraft carry the planned load?
- Can this aircraft operate at the altitudes needed for the trip?
- Does this aircraft have sufficient fuel capacity, with reserves, for trip legs planned?
- Does the fuel quantity delivered match the fuel quantity ordered?

V = EnVironment

Weather
Weather is a major environmental consideration. Earlier it was suggested pilots set their own personal minimums, especially when it comes to weather. As pilots evaluate the weather for a particular flight, they should consider the following:
- What is the current ceiling and visibility? In mountainous terrain, consider having higher minimums for ceiling and visibility, particularly if the terrain is unfamiliar.
- Consider the possibility that the weather may be different than forecast. Have alternative plans and be ready and willing to divert, should an unexpected change occur.
- Consider the winds at the airports being used and the strength of the crosswind component.
- If flying in mountainous terrain, consider whether there are strong winds aloft. Strong winds in mountainous terrain can cause severe turbulence and downdrafts and be very hazardous for aircraft even when there is no other significant weather.
- Are there any thunderstorms present or forecast?
- If there are clouds, is there any icing, current or forecast? What is the temperature/dew point spread and the current temperature at altitude? Can descent be made safely all along the route?
- If icing conditions are encountered, is the pilot experienced at operating the aircraft’s deicing or anti-icing equipment? Is this equipment in good condition and functional? For what icing conditions is the aircraft rated, if any?

Terrain
Evaluation of terrain is another important component of analyzing the flight environment.
- To avoid terrain and obstacles, especially at night or in low visibility, determine safe altitudes in advance by using the altitudes shown on VFR and IFR charts during preflight planning.

- Use maximum elevation figures (MEFs) and other easily obtainable data to minimize chances of an in-flight collision with terrain or obstacles.

Airport
- What lights are available at the destination and alternate airports? VASI/PAPI or ILS glide-slope guidance? Is the terminal airport equipped with them? Are they working? Will the pilot need to use the radio to activate the airport lights?
- Check the Notices to Airmen (NOTAMS) for closed runways or airports. Look for runway or beacon lights out, nearby towers, etc.
- Choose the flight route wisely. An engine failure gives the nearby airports supreme importance.
- Are there shorter or obstructed fields at the destination and/or alternate airports?

Airspace
- If the trip is over remote areas, are appropriate clothing, water, and survival gear onboard in the event of a forced landing?
- If the trip includes flying over water or unpopulated areas with the chance of losing visual reference to the horizon, the pilot must be prepared to fly IFR.
- Check the airspace and any temporary flight restriction (TFRs) along the route of flight.

Night time
Night flying requires special consideration.
- If the trip includes flying at night over water or unpopulated areas with the chance of losing visual reference to the horizon, the pilot must be prepared to fly IFR.
- Will the flight conditions allow a safe emergency landing at night?
- Preflight all aircraft lights, interior and exterior, for a night flight. Carry at least two flashlights—one for exterior preflight and a smaller one that can be dimmed and kept nearby.

E = External Pressures

External pressures are influences external to the flight that create a sense of pressure to complete a flight—often at the expense of safety. Factors that can be external pressures include the following:
- Someone waiting at the airport for the flight's arrival.
- A passenger the pilot does not want to disappoint.
- The desire to demonstrate pilot qualifications.
- The desire to impress someone. (Probably the two most dangerous words in aviation are "Watch this!")
- The desire to satisfy a specific personal goal ("get-home-itis," "get-there-itis," and "let's-go-itis").
- The pilot's general goal-completion orientation.
- Emotional pressure associated with acknowledging that skill and experience levels may be lower than a pilot would like them to be. Pride can be a powerful external factor!

Managing External Pressures.
Management of external pressure is the single most important key to risk management because it is the one risk factor category that can cause a pilot to ignore all the other risk factors. External pressures put time-related pressure on the pilot and figure into a majority of accidents.

The use of personal *Standard Operating Procedures (SOPs)* is one way to manage external pressures. The goal is to supply a release for the external pressures of a flight. These procedures include but are not limited to:
- Allow time on a trip for an extra fuel stop or to make an unexpected landing because of weather.
- Have alternate plans for a late arrival or make backup airline reservations for must-be-there trips.
- For really important trips, plan to leave early enough so that there would still be time to drive to the destination.
- Advise those who are waiting at the destination that the arrival may be delayed. Know how to notify them when delays are encountered.

- Manage passengers' expectations. Make sure passengers know that they might not arrive on a firm schedule, and if they must arrive by a certain time, they should make alternative plans.
- Eliminate pressure to return home, even on a casual day flight, by carrying a small overnight kit containing prescriptions, contact lens solutions, toiletries, or other necessities on every flight.

The key to managing external pressure is to be ready for and accept delays. Remember that people get delayed when traveling on airlines, driving a car, or taking a bus. The pilot's goal is to manage risk, not create hazards.

Personal Minimums Checklist and Recommendations

General Aircraft Experience

Single-engine fixed-gear: ___ hours in past ___ months
FAA requires: None.
ASI recommends: Three hours in any make/model within previous three months.

Single-engine retractable-gear: ___ hours in past ___ months
FAA requires: None.
ASI recommends: Three hours in any retractable-gear make/model within previous three months.

Multiengine: ___ hours in past ___ months
FAA requires: None.
ASI recommends: Three hours in same or similar make/model within previous three months.

Operational Currency / Proficiency

Flight review within previous ___ months
FAA requires: 24 calendar months (FAR 61.56(c)).
ASI recommends: 12 calendar months; if instrument rated, the flight review should include an instrument proficiency check (IPC), regardless of legal instrument currency.

Day landings: ___ landings in previous ___ days
FAA requires: Three landings in previous 90 days when carrying passengers (FAR 61.57(a)).
Tailwheel—Three full-stop landings in any tailwheel make/model within previous 90 days.
ASI recommends:

- *One landing in previous 30 days, in addition to the FAA requirement*
- *Tailwheel—Three full-stop landings in any tailwheel make/model within previous 30 days*

Night landings: ___ night landings in previous ___ days
FAA requires: Three full-stop night landings in previous 90 days when carrying passengers (FAR 61.57(b)).
ASI recommends:

- *One full-stop night landing in previous 30 days, in addition to the FAA requirement*
- *Tailwheel—Three full-stop landings at night in any tailwheel make/model within previous 30 days*

IFR: ___ instrument hours and ___ instrument approaches in the past ___ days/months
FAA requires: Six instrument approaches, intercepting, tracking and holding in previous six calendar months (FAR 61.57c).
ASI recommends: In addition to the FAA requirement, one hour of actual or simulated instrument flight and one instrument approach in previous 30 days; also, an IPC within the previous six calendar months.

Weather Conditions

VFR
Ceiling ___ feet/visibility ___ miles
FAA requires: Airspace-dependent—no less than clear of clouds, one mile visibility (FAR 91.155).
ASI recommends:

- *Outside traffic pattern—no less than 2,000 foot ceiling and five miles visibility*
- *Within traffic pattern—1,500 foot ceiling and three miles. Use caution in mountainous terrain*

IFR - Departure
Ceiling ___ feet/visibility ___ miles
FAA requires: None.
ASI recommends: Local instrument approach minimums, so that an immediate return can be made. If the airport has no instrument approach, use minimums from the nearest suitable airport with an instrument approach within 15 minutes.

IFR - Arrival
Ceiling ___ feet/visibility ___ miles
FAA requirement: Instrument approach minimums
ASI recommends:

- *Precision approach: 400 feet and one mile.*
- *Non-precision approach: Lowest minimums applicable plus 200 feet and one-half mile. Example: if approach minimums are 450 feet and one mile, personal minimums would be 650 feet and 1.5 miles.*
- *Circling approach: Published minimums or 1,000 foot ceiling and three miles, whichever is higher; not recommended at night.*

Crosswind component
No more than ___ knots
FAA requires: None.
ASI recommends:

- *75 percent of maximum demonstrated crosswind.*

Example: 16 (knots max demonstrated crosswind) x .75 = 12 knots recommended crosswind component

- *Tailwheel—no more than 10 knots of crosswind*

Fuel Reserve

Day VFR: ___ hour(s) ___ minutes
Night VFR: ___ hour(s) ___ minutes
IFR: ___ hour(s) ___ minutes
FAA requires:
Day VFR: 30 minutes.
Night VFR: 45 minutes.
Day or Night IFR: 45 minutes. (FAR 91.151, 91.167)
ASI recommends: Minimum 60 minutes for all, assuming that all contingencies have been accounted for (diversions, holding, headwinds, etc.). In other words, the airplane should land with at least one hour of fuel in the tanks.

Other

Rest: ___ hours of rest (sleep and relaxation) in previous 24 hours
FAA requires: None.
ASI recommends: 10 hours.

A Guide to Pulse Oximetry, Blood Oxygen Levels, and Supplemental Oxygen for Pilots and Crew

What is blood oxygen?
Simply stated, it is the amount of oxygen (O_2) found in the blood. Each molecule of hemoglobin holds 4 molecules of O_2. Hemoglobin is an iron compound that "rusts" in the presence of oxygen, turning it red. Oxygen is used by the cells to burn food fuel components (carbohydrates, proteins, fats) and excretes Carbon Dioxide (CO2) as waste.

Normal room air is 20% oxygen. In a healthy person at MSL, the oxygen saturation of the blood should be between 95-100%. After metabolism, the oxygen in the blood is lower, so when it gets to the room air in the lungs, the differences in pressure of O_2 and CO_2 equalize, with oxygen coming into the blood and carbon dioxide going out of the lungs.

The amount of oxygen in the blood, then, is a function of both oxygen in the air and partial pressure of oxygen.

What happens at altitude?
It's important to remember that blood oxygen level is a function of both O_2 amount and pressure. At altitude, both the amount and pressure of O_2 decrease. Most healthy people can make up for the decreased amount of O_2 by simply breathing faster, which increases the amount of O_2 getting to the blood.

This only works until about 8,000 feet. (This is why commercial airlines are only pressurized to 8,000 feet ASL.) At this point the blood O_2 level begins to drop

Above that, supplemental O_2 is needed to maintain normal blood O_2 levels of 95-100%. But even supplemental O_2 will only last so long before the pressure is so low that even breathing 100% oxygen won't keep up with the body's demands. It is at this point that the plane must be pressurized.

What Does the FAA Say?
Part 91, Section 211 of the FARs state:
"No person may operate a civil aircraft:

1. At cabin pressure altitudes above 12,500 feet MSL, *unless* the flight crew is provided with and uses supplemental oxygen for that portion of the flight that is more than 30 minutes duration
2. At cabin pressure altitudes above 14,000 feet MSL*, unless* the required minimum flight crew uses supplemental oxygen during the entire flight at those altitudes.
3. At cabin pressure altitudes above 15,000 feet MSL, *unless every* occupant of the aircraft is using supplemental oxygen."

Why Not Just Adhere to the FARs and Forget About Blood O2?
Of course, you must adhere to the FARs. But that is like saying that drivers should not exceed the posted speed limit. Things like visibility and road conditions may make the correct speed limit much lower. Just so with the FARs and use of supplemental O_2. Different people have different metabolism, may have illnesses that affect lung capacity, may have some anemia that keeps the blood from absorbing enough O_2, may have alcohol or drugs "on board" and so forth. Remember, the ability to maintain normal blood O_2 levels by breathing faster ends at about 8,000 feet. Above that, even a fit, healthy person begins to have decreased blood O_2. The only way to tell what is happening to each individual is to use pulse oximetry.

What is a Pulse Oximeter and How Does it Work?
It is a transducer that measures the reflection of light from the skin under the nail bed. The color reflected from the little light source in the oximeter is measured and sent to the little mini-computer that interprets the results and tells about what percentage of O_2 is in the blood. For that reason it is important that the following be observed when applying the oximeter probe to a finger:

- The finger should have a minimum of nail polish, particularly dark colors and red and blue. Normally the index finger is used, although ring fingers or even smaller thumbs may suffice.

- The finger should be warmed up by rubbing briskly to make sure there blood is flowing normally, or a false reading may result.
- The finger should be inserted nail up (towards the readout) all the way to the end of the probe.
- Follow the manufacturer's instructions for operation of the unit, then keep motion to a minimum, as movement can also give a false reading.
- After the readout is displayed, note the larger number on the top (the percentage of O_2) and the lower number (the pulse rate.)

What Do I Do With the Results?
Any reading between 95% and 100% is considered normal. By the time the blood O_2 gets to 93%, complex computations begin to get more difficult. By 90% to 91%, there is a noticeable effect on psychomotor functioning and the pilot should start using supplemental O_2. One of the primary effects of early hypoxia is headache, and O_2 for any passengers that complain of pain for any more than a few minutes may be relieved by O_2 as well. If the pilot sees O_2 level drop below 90% for any period of time, say 15 minutes, he should seek lower altitudes until the level returns to at least 90%, but preferably at least 93%.

By the time the O_2 level is below 90%, you are becoming hypoxic. Anything below 85% is severe hypoxia, and at 75%, it becomes a medical emergency requiring a pressure ventilator.

Mask vs. Nasal Cannula
The nasal cannula is less obtrusive than the mask, but can provide only a portion of what a mask can provide. When increasing the amount of O_2 from, say 2 lpm to 10 lpm, it would be wise to also switch from nasal cannula to mask, both to increase the amount of O_2 that gets to the lungs but to make more efficient use of the O_2 by preventing waste of unused O_2.

Care of the Oximeter
- It is advisable to keep the unit in a case. As with any instrument, damage can occur with moisture, falls or high temperature.
- Some packaged alcohol swabs should be kept in the case or handy to clean out the inside of the probe after each use. Buildup of skin oils can affect performance.
- From time to time it is advisable to measure against another unit, and consider calibration if it deviates much from a new unit.
- Make sure batteries are fresh and remove them if the unit will not be in use for a while. Keep them in the case, though, so you remember to insert them before flight to higher altitudes. Keep spare batteries handy. Lithium batteries can extend the useful life by a factor of 4-6 times. Most units will provide around 2,000 to 2,500 readings on one set of batteries.

Recommended reading

Use of "COMPASSION" Call sign for VPO flights

http://www.aircareall.org/callsign.htm#cmpsn-procedures

Additional Resources

Baja Bush Pilots
http://www.bajabushpilots.com