Chapter 13: Human Factors

Introduction

The study of human factors involves different disciplines. [*Figure 13-1*] When referring to human factors, engineers sometimes refer to the 3Ds: design, development, and deployment of systems that improve the system/human interface. Study of human factors also involves understanding and preventing human errors engineers cannot prevent using the 3Ds. This chapter focuses on the human element—pilot attitudes, pilot error, physiological issues related to soaring safety, pilot management of a glider and its systems, and pilot decision-making as a process that can mitigate glider flight risk and prevent many common types of accidents. For more information on human factors and risk, see the Risk Management Handbook (FAA-H-8083-2) or the Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25).

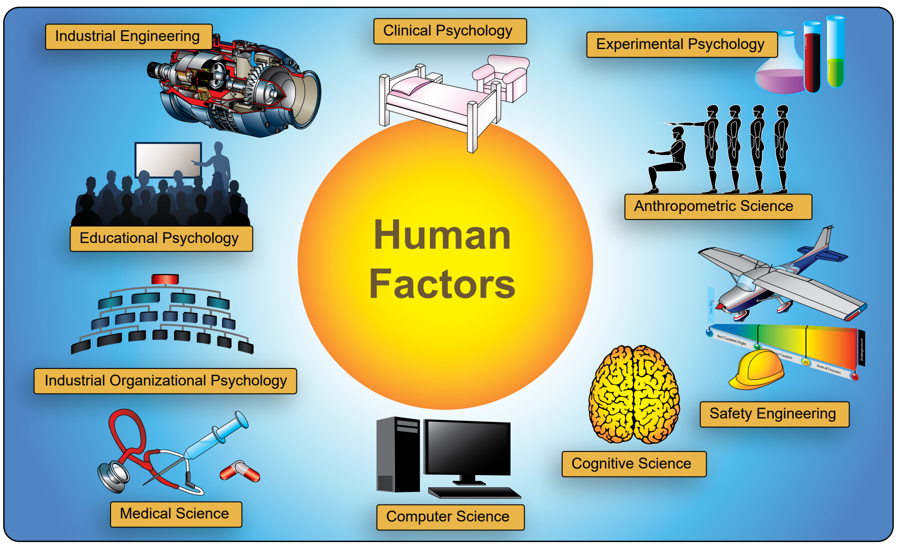

Figure 13-1. *Human factor disciplines.*

Recognizing Hazardous Attitudes

Hazardous attitudes lead to hazardous behaviors that include complacency, indiscipline, and overconfidence, which all increase the risk of a glider accident.

Complacency

Complacency can occur if a pilot feels a false sense of security about the surroundings. This could affect a glider pilot who just wants to fly and does not comprehend the hazards and associated risks. Complacency also affects glider pilots who no longer feel obligated to adhere to standard safety precautions (e.g., "I've done this a million times and don't need to refer to a checklist.").

A few countermeasures include:

- Setting aside sufficient time to prepare for each flight.
- Examining hazards and addressing the associated risk of each flight.
- Challenging oneself to meet a standard of excellence on each flight.

Indiscipline

Aviation accidents sometimes result from pilot failure to comply with regulatory standards. Having the discipline to follow the rules reduces the chance of an accident.

The regulatory requirements set a standard for safety. Pilots should consider developing more stringent personal limitations that may be modified as their experience and proficiency grow. For example, the pilot could establish minimum visibility and wind conditions for flight. In that case, the pilot would not fly if conditions exceeded established personal minimums. A disciplined pilot would only lower personal minimums based on training and rational decision making and not based on a desire to make a particular flight. In addition, a pilot might raise the minimums if under additional stress from personal or work-related issues or if flying infrequently.

Sometimes pilots feel their experience has taught them an easier or faster way to do certain tasks. They should ask themselves if their attitude and procedures align with guidelines set forth by disciplined aviators. If not, these pilots should consider that standardized procedures, rules, and formal risk mitigation strategies offer better protection from accidents.

Pilots interested in more information about a disciplined approach to aviation safety can refer to the FAA Risk Management Handbook (FAA-H-8083-2), which describes structured techniques pilots can use that include how to set or revise personal minimums and how to conduct a disciplined and thorough safety analysis before flight.

Overconfidence

A realistic level of confidence enables a pilot to feel good about a particular flight operation. That confidence comes from experience, training, proficiency, adequate preparation for a flight, and ongoing discipline.

Overconfidence reflects a lack of understanding about the pilot's own limitations, not understanding the aircraft or conditions that could threaten the safety of flight, denial of the reality of pilot shortcomings, or a desire to prove something. Whatever the cause, unjustified confidence can lead to an accident. Pilots should carefully consider their limitations when attempting to fly in an unfamiliar glider or in an unfamiliar environment and resist letting overconfidence or pride interfere with good judgment. Glider pilots who do not fly regularly or who have not flown for several months should recognize the different levels of safety that come from having a current flight review every two years, meeting take-off and landing currency requirements, and having the level of proficiency necessary given the current conditions.

Pilot Error

All pilots make errors, and many pilots may have gaps in knowledge. Training assessments, flight examinations (written or oral), operational checks, critiques, and post-flight pilot self-assessments can highlight what a pilot can do better. An honest and fair assessment can lead to correction of any shortcomings and reduce the potential for accidents.

Types of Errors

One type of unintentional error involves failure to perform an intended action within acceptable tolerances. On the other hand, an incorrect opinion, bad judgment, poor reasoning, careless attitude, or insufficient knowledge can cause a more serious mistake. For example, a pilot with good stick and rudder skills but new to ridge soaring might fly into strong sink on the downwind side of a ridge and narrowly escape hitting terrain. The pilot's lack of knowledge and bad judgment could lead to this kind of mistake.

Intentional

If a pilot knowingly does something wrong, that pilot intentionally deviated from safe practices, procedures, standards, or regulations. In aviation, an intentional error suggests a serious and underlying lack of concern for safety. The pilot should reflect on the reason for the error, seek advice or counseling, and not fly unless able to prevent that behavior.

Fatigue

Fatigue involves a reduction or impairment in any of the following: cognitive ability, decision-making, reaction time, coordination, speed, strength, and balance. Fatigue reduces alertness and often reduces a person's ability to focus and hold attention on a task. [*Figure 13-2*] Emotional fatigue exists and can affect mental and physical performance. Lack of sleep, stress, and overwork can all cause or aggravate fatigue.

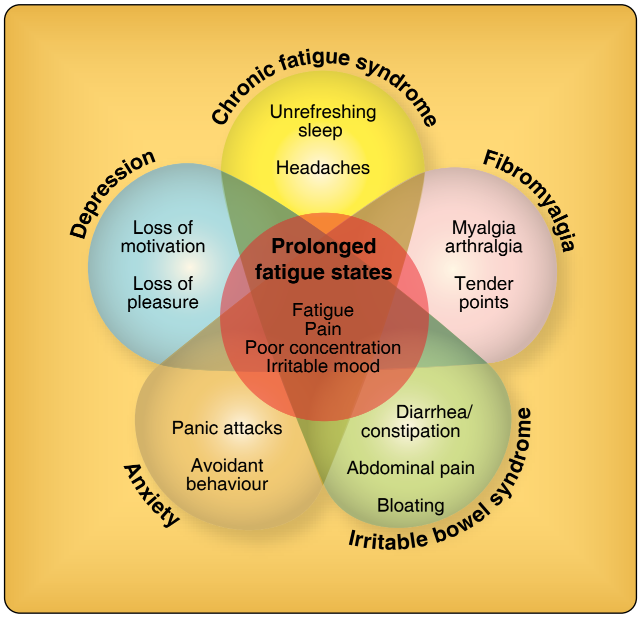

Figure 13-2. *Sampling of factors that interact with fatigue.*

A person's mental and physical state naturally cycles through various levels of performance each day. Variables such as body temperature, blood pressure, heart rate, blood chemistry, alertness, and attention rise and fall in a daily pattern known as a circadian rhythm. [*Figure 13-3*] A person's ability to work and rest rises and falls during this cycle. Activity contrary to a person's circadian rhythm can cause subtle difficulties and fatigue. An affected person might not recognize this situation. Since another person might alert a pilot to the signs of fatigue, flying a glider alone when fatigued creates a particularly dangerous situation. For example, a fatigued glider pilot might not actively see and avoid other traffic. Pilots should avoid flying when not having full night's rest, after working excessive hours, or after an especially exhausting or stressful day.

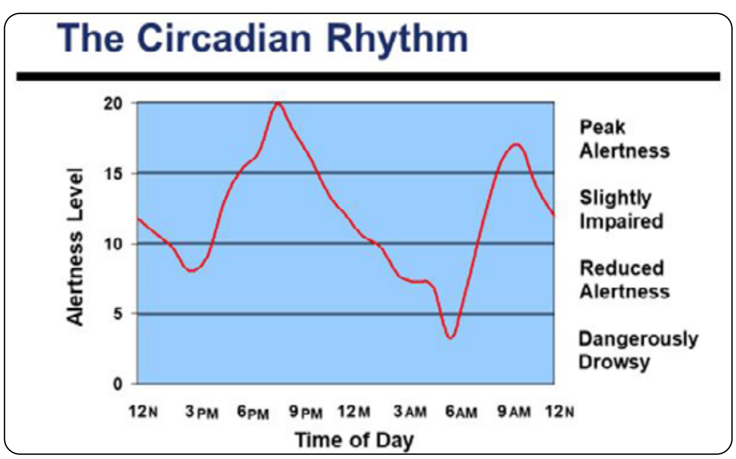

Figure 13-3. *Many human performance factors rise and fall daily.*

The best remedy for fatigue involves getting enough sleep on a regular basis. Pilots should track their hours and quality of sleep for fatigue awareness. Countermeasures to fatigue such as caffeine, may work for a short duration, but many countermeasures may make fatigue worse over the long term. Pilots should exercise caution if using medication to fight fatigue since a fatigued person may have trouble getting needed rest after using medication. A pilot experiencing ongoing fatigue issues or chronic fatigue, should stop flying a glider, consult a physician, and resolve the issue before flying again.

Hyperventilation

Hyperventilation results when a person breathes at an increased rate or breathes more deeply, which reduces the level of carbon dioxide in the blood. Reduced carbon dioxide in the blood can raise blood pH and lead to undesirable health effects.

Hyperventilation might occur as result of emotional stress, fright, or pain. Glider pilots who encounter extreme or unexpected turbulence or strong areas of sink over rough terrain or water may unconsciously increase their breathing rate or breathing volume. When flying at higher altitudes, either with or without oxygen, a tendency to breathe more rapidly than normal may occur.

Figure 13-4 lists the common symptoms of hyperventilation. Treatment for hyperventilation involves restoring the proper carbon dioxide level. Consciously slowing the breathing rate or talking aloud can reverse the effects of hyperventilation. Recovery usually occurs rapidly once the breathing rate returns to normal. In rare cases, hyperventilation can cause unconsciousness.

Common Symptoms of Hyperventilation
Headache
Decreased reaction time
Impaired judgment
Euphoria
Visual impairment
Drowsiness
Lightheaded or dizzy sensation
Tingling in fingers and toes
Numbness
Pale, clammy appearance
Muscle spasms

Figure 13-4. *Common symptoms of hyperventilation.*

Hypoxia

Hypoxia results from reduced oxygen or not enough oxygen. Although human cell tissue will die if deprived of oxygen long enough, the principal concern for pilots is lack of oxygen to the brain, which can reduce cognitive ability and result in life-threatening errors. Hypoxia has several causal factors, including an insufficient supply of oxygen, inadequate transportation of oxygen, or the inability of the body tissues to use oxygen. The forms of hypoxia are based on their causes:

Hypoxic Hypoxia

Hypoxic hypoxia results from insufficient oxygen available to the body as a whole. The reduction in partial pressure of oxygen at high altitude can cause a pilot to experience this type of hypoxia. As an unpressurized aircraft ascends during flight, the percentage of atmospheric oxygen remains constant, but a reduced number of oxygen molecules enter the lungs and pass between the membranes within the respiratory system.

Hypemic Hypoxia

Hypemic hypoxia occurs when the blood cannot take up sufficient oxygen. Causes of this form of hypoxia include reduced blood volume from severe bleeding or certain blood diseases, such as anemia. Carbon monoxide poisoning causes this type of hypoxia. Hemoglobin, the blood molecule that transports oxygen, becomes chemically unable to bind oxygen molecules if exposed to carbon monoxide. Hypemic hypoxia can also occur after a blood donation. While blood volume normalizes quickly following a donation, restoring the lost hemoglobin can take several weeks. Although the effects of the blood loss seem slight at ground level, blood donation can create a flight risk during the recovery period.

Stagnant Hypoxia

Stagnant hypoxia or ischemia results when the oxygen-rich blood in the lungs does not move to the tissues that need it. An arm or leg going to sleep because of restricted blood flow is one form of stagnant hypoxia. This kind of hypoxia can also result from shock, the heart failing to pump blood effectively, or a constricted artery. During flight, excessive G forces can cause stagnant hypoxia. Cold temperatures can also reduce circulation and decrease blood supply to extremities.

Histotoxic Hypoxia

When histotoxic hypoxia occurs, the body transports enough oxygen to the cells, but they cannot make use of it. This impairment of respiration at the cellular level may result from alcohol consumption, exposure to certain drugs or narcotics, or exposure to poisons.

Symptoms of Hypoxia

Oxygen starvation causes impairment of the brain and other vital organs. The first symptoms of hypoxia can include euphoria and a carefree feeling. With increased oxygen deprivation, the extremities become less responsive and flying becomes less coordinated. The symptoms of hypoxia vary with the individual, but common symptoms include:

- Cyanosis (blue fingernails and lips).
- Headache
- Decreased response to stimuli and increased reaction time,
- Impaired judgment
- Euphoria
- Visual impairment
- Drowsiness
- Lightheaded or dizzy sensation
- Tingling in fingers and toes
- Numbness

As hypoxia worsens, the pilot's field of vision begins to narrow, and instrument interpretation can become difficult. Even with all these symptoms, the effects of hypoxia can give a pilot a false sense of security.

Treatment of Hypoxia

Treatment for hypoxia involves increasing the amount of available oxygen. Pilots commonly descend to lower altitudes or use supplemental oxygen to counteract the effects of hypoxia. Time of useful consciousness gives the maximum time available for the pilot to make rational, life-saving decisions and carry them out at a specific altitude without supplemental oxygen. As altitude increases above 10,000 feet, the symptoms of hypoxia increase, and the time of useful consciousness diminishes significantly. [*Figure 13-5*]

Altitude	Time of useful consciousness
45,000 feet MSL	9 to 15 seconds
40,000 feet MSL	15 to 20 seconds
35,000 feet MSL	30 to 60 seconds
30,000 feet MSL	1 to 2 minutes
28,000 feet MSL	2½ to 3 minutes
25,000 feet MSL	3 to 5 minutes
22,000 feet MSL	5 to 10 minutes
20,000 feet MSL	30 minutes or more

Figure 13-5. *Time of useful consciousness.*

Since individuals experience hypoxia differently, experiencing the effects of hypoxia in an altitude chamber [*Figure 13-6*] can improve an individual's recognition of their own symptoms. The Federal Aviation Administration (FAA) provides this opportunity through aviation physiology training, which occurs at the FAA Civil Aerospace Medical Institute (CAMI) in Oklahoma City, Oklahoma, and at many military facilities across the United States. For information about the FAA's one-day physiological training course with altitude chamber and vertigo demonstrations, visit the FAA website.

Figure 13-6. *CAMI altitude chamber.*

Inner Ear Discomfort

The internal pressure of the middle ear cavity changes more slowly than the pressure outside the ear. A pressure difference can develop during an ascent or descent, which may result in temporary hearing loss, discomfort, pain, and distraction from flight tasks.

When a glider ascends, middle ear air pressure may exceed the pressure of the air in the external ear canal, causing the eardrum to bulge outward. This condition usually resolves itself, and the pilot may notice a popping sound as pressure equalizes and hearing sensitivity returns to normal. During a descent, pressure of the air in the external ear canal may increase above that of the middle ear cavity, which causes the eardrum to bulge inward. The condition during a descent seems more painful and unpleasant to most people. Nasal congestion or a cold can make pressure equalization difficult or impossible. Chewing gum, sucking on hard candy, or swallowing might assist pressure equalization during a descent.

Discomfort during a descent ends when enough air flows into the middle ear through the eustachian tube. However, the lower pressure in the middle ear tends to constrict the walls of the eustachian tube and prevent the flow of air to the middle ear. A pilot can try the Valsalva maneuver to correct this situation. The pilot should pinch the nostrils, close the mouth and lips, and blow slowly and gently in the mouth and nose to force air up the eustachian tube into the middle ear.

Scuba Diving

Scuba diving subjects the body to increased pressure, which dissolves more nitrogen in body tissues and fluids. The reduction of atmospheric pressure that accompanies flying can produce physical problems for scuba divers when small bubbles of nitrogen to form inside the body as the gas comes out of solution. These bubbles can cause a painful and potentially incapacitating condition called the bends.

Scuba training emphasizes how to prevent the bends when rising to the surface of a body of water. However, excess nitrogen can remain in tissue fluids for several hours after finishing a dive. A pilot who SCUBA dives can experience the bends from as low as 8,000 feet MSL, with increasing severity as altitude increases. As noted in the Aeronautical Information Manual (AIM), the minimum recommended time between scuba diving on non- decompression stop dives and flying is 12 hours, while the minimum time recommended between decompression stop diving and flying is 24 hours.

Spatial Disorientation

Most gliders used for primary training have basic instrumentation only, and glider pilots do not normally train for flight solely by reference to instruments. Glider pilots should avoid flight in low visibility or in any condition that makes discerning the horizon difficult. These conditions increase the likelihood that the pilot will succumb to an illusion and experience a loss of control. [*Figure 13-7*] Glider pilots who fly in marginal visibility should establish and abide by personal minimums for visibility.

Figure 13-7. *Flying in haze or other restrictions to visibility increases the likelihood of spatial disorientation.*

Flight in a powered glider may occur at night or in instrument conditions provided the glider meets the requirements of 14 CFR part 91, section 91.205, and the pilot meets the applicable requirements of 14 CFR part 61, section 61.57. Pilots have fewer visual cues available to judge flight attitude at night or in instrument conditions. Both regimes present additional potential for illusions, navigation errors, collisions, and loss of control. In addition, any emergency at night becomes much more difficult to handle. Glider pilots who fly in these conditions normally have ratings in other aircraft categories that include training and testing for night or instrument conditions. A glider pilot without additional training, certification, recency, and proficiency should avoid night or instrument operations.

Dehydration

Glider pilots often fly for long periods of time in hot summer temperatures or at high altitudes that can cause dehydration. Although the effects of dehydration may develop slowly, fluid loss from perspiration and breathing can result in fatigue and progress to dizziness, weakness, nausea, tingling of hands and feet, abdominal cramps, and extreme thirst. [*Figure 13-8*]

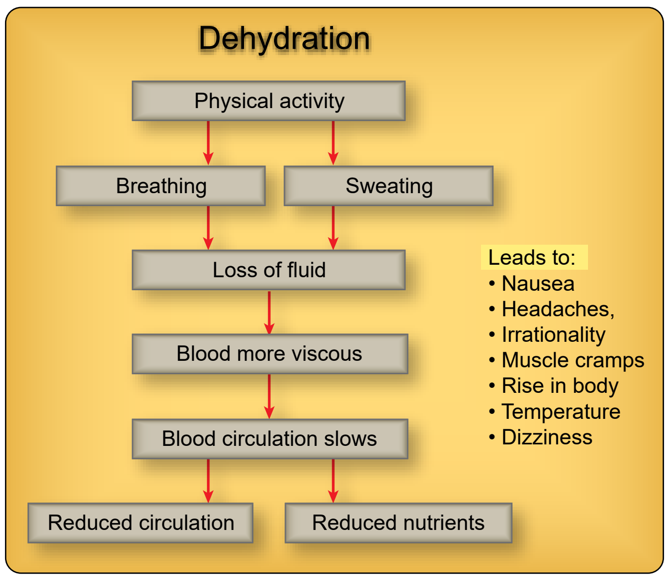

Figure 13-8. *Symptoms of dehydration.*

Pilots should take water on every flight to prevent dehydration. Some glider pilots wear a hat with a rim for shade and to keep a cool head. Pilots should ensure that the brim of the hat does not interfere with the ability to scan for other gliders and air traffic.

Heatstroke

Heatstroke results when the body cannot control excessive high temperature. Onset of this condition may mimic dehydration, but it may also lead to collapse. To prevent these symptoms, the pilot should carry an ample supply of water and use it at frequent intervals on any long flight, even if not thirsty. Wearing light-colored, porous clothing and a hat provides protection from the sun. Ventilating the cabin also helps remove excess heat.

Cold Weather

Preparing for extreme cold may seem odd when comfortable temperatures exist at ground level on wave soaring days. However, when flying at high altitudes, the inside of the glider can get cold. A glider at a high altitude can encounter temperatures of -30° to -60 °C. When soaring, sunshine through the canopy can keep the pilot's upper body warm for a time, but shaded legs and feet can quickly chill or suffer frostbite. After an hour or two at such temperatures, even the upper body can become quite cold. Layered, loose-fitting clothing helps insulate body heat. Either wool gloves or fitted gloves with mittens over them can protect the hands. Two or three pairs of socks in layers with silk on the inside and wool on the outside plus an insulated boot can help keep feet comfortable. Clothing manufacturers produce clothing and socks with internal heating elements and rechargeable lithium batteries that the pilot can turn on and regulate. These make a great addition to a glider pilot's wardrobe.

Low temperatures can cause other unpleasant or hazardous conditions. Pilot or passenger exhaled moisture can condense and then freeze or deposit directly as frost on the inside of the canopy. The pilot can use a clean piece of cloth that does not damage the canopy to wipe off condensation or light frost. Allowing fresh air through a vent can clear condensation and stop frost formation. Unfortunately, this also quickly lowers the inside temperature, and may require adding a layer of clothing.

The body dehydrates more rapidly in extreme cold and refraining from drinking water can cause dehydration even in cold conditions. Because cold weather causes the kidneys to excrete liquid at a faster rate, the pilot should make a bathroom stop before takeoff and consider a relief system for the flight.

Cabin Management & Equipment

Prior to launch, the pilot should brief any passengers on use of safety belts, shoulder harnesses, and emergency procedures. The pilot should check the security of any trim ballast, organize the items carried onboard, and properly stow and secure all other items. Placement of charts, tablets, and cross-country aids should allow the pilot to reach them easily.

Parachute

Pilots may use a parachute for emergencies. A certificated and appropriately rated parachute rigger must repack a nylon parachute within the preceding 180 days. The packing date information is usually found on a card contained in a small pocket on the body of the parachute. Refer to 14 CFR, part 91, section 91.307 for more information.

Supplemental Oxygen

High-altitude soaring flights require the use of supplemental oxygen. In some parts of the country, soaring routinely occurs to a 16,000- to 18,000-foot cloud base in thermals. Flight using mountain waves may lead to flight at altitudes more than 30,000 feet in the United States.

Breathing supplies oxygen to the blood and removes carbon dioxide. In each breath at 18,000 feet, the pilot breathes in only half as much oxygen as at sea level. The pilot's automatic reaction without an adequate supply of oxygen would involve breathing twice as fast. This hyperventilation, or over-breathing, would result in eliminating too much carbon dioxide from the blood.

14 CFR, part 91, section 91.211, dictates time and altitude requirements for use of supplemental oxygen. Prior to use of supplemental oxygen, the system should be checked for oxygen availability and flow. The pilot can use the PRICE checklist:

- P = Pressure
- R = Regulator
- I = Indicator
- C = Connections
- E = Emergency bail-out bottle

Aviation Oxygen Systems

A portable aviation oxygen system delivers oxygen using lightweight and compact components. It delivers a calibrated amount of oxygen based on extensive research in human flight physiology. Prior to purchasing any type of oxygen system, pilots should consider the type of flying they do. Two different common types of systems used today include the Continuous-Flow System and the Electronic Pulse Demand Oxygen System (EDS). Pilots should only use aviator's oxygen supplied in a green bottle with these systems and never use medical oxygen. Medical oxygen may contain water and could render a pilot's oxygen system unworkable.

Continuous-Flow System

The continuous-flow system uses a high-pressure storage tank and a pressure-reducing regulating valve that reduces the pressure in the cylinder to approximately atmospheric pressure at the mask. [*Figure 13-9*] The oxygen flows continuously when the system is turned on provided the bottle contains sufficient oxygen. In some installations, the pilot can adjust the amount of oxygen flow manually for low, intermediate, and high altitudes; automatic regulators adjust the oxygen flow by means of a bellows, which varies the flow according to altitude. When using the continuous-flow oxygen system, the pilot can use either an oxygen mask or a nasal cannula. [*Figures 13-10* and *13-11*]

Figure 13-9. *Continuous-flow oxygen system.*

Figure 13-10. *Oxygen mask.*

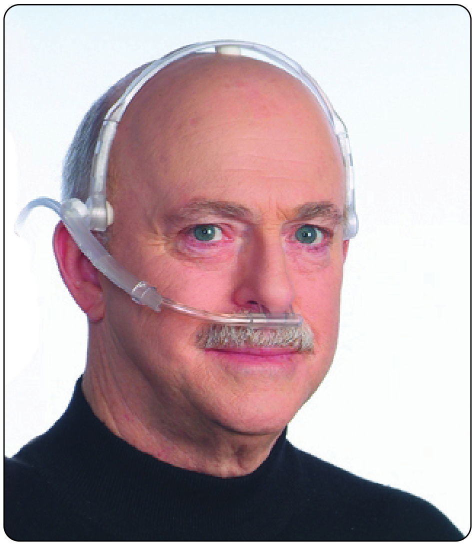

Figure 13-11. *Nasal cannula.*

Electronic Pulse Demand Oxygen System (EDS)

The EDS delivers altitude-compensated pulses of oxygen only when the pilot inhales. It typically uses 1⁄6 the amount of oxygen at 1⁄4 the weight and volume of conventional constant-flow systems. [*Figure 13-12*] The EDS has a micro-electronic pressure altitude barometer that automatically determines the volume for each oxygen pulse up to pressure altitudes of 32,000 feet. The EDS automatically goes to a 100 percent pulse-demand mode at pressure altitudes above 32,000 feet.

Figure 13-12. *Electronic Pulse Demand Oxygen System (EDS).*

The pilot can set an EDS to different modes and delays. For example, it can respond with oxygen at altitudes where needed and conserve oxygen at lower altitudes. It can also be set to night or now mode where it responds from sea-level and up. The EDS limits its response to a maximum respiration rate of about 20 breaths per minute, virtually eliminating any hyperventilation. The pilot turns it on and does not need to read scales or adjust any knobs when climbing or descending. These devices need no local altimeter setting since they respond directly to pressure altitude, just as the body does.

Risk Management

Risk management for pilots includes identification of hazards that pose a flight risk, assessment of the level of risk associated with each hazard, and decision making to manage and mitigate any unacceptable risks.

Hazards include any condition that can foreseeably cause or contribute to an aircraft accident. Typical hazards include pilot condition or lack of proficiency, aircraft or equipment malfunctions or shortcomings, and environmental conditions that include weather, mountains, obstacles, other aircraft, wires, and high-altitude flight. Any external pressure to take a particular flight can create an additional hazard. These items form part of the PAVE checklist (Pilot, Aircraft, enVironment, External pressure) that pilots can use to consider and manage common flight risks.

The composite of predicted severity and likelihood of the potential effect of a hazard constitutes the risk. The level of risk associated with a hazard depends on the likelihood of an accident and the severity of damage or injury that could occur. Risk mitigation involves an analysis and implementation of changes the pilot can make to lower the level of risk. For example, a glider pilot recognizes the risk associated with a tow line break. The pilot lowers the level of this risk by training for this possibility. Before each tow, the pilot should also consider a plan of action in the event of a rope break. If that consideration does not adequately mitigate that risk for the given set of conditions on a particular day, the pilot might decide to wait for the winds to change, ask for a different direction of tow, or postpone or cancel the operation.

Safety Management System (SMS)

This Handbook focuses on the individual and not on safety management systems (SMS). SMS addresses risk management from an organizational perspective as an ongoing activity. Interested persons may obtain information about SMS from the Risk Management Handbook (FAA-H-8083-2).

Aeronautical Decision-Making (ADM)

A pilot makes numerous aeronautical decisions involving risk management before a flight begins. One structured means involves using a Flight Risk Assessment Tool or FRAT. Pilots can check the FAA Risk Management Handbook (FAA-H-8083-2) for a sample FRAT and can use one to enhance the safety of flight.

FAA regulations set up specific minimum safety requirements for some conditions, but that does not mean every pilot has the capability to fly in those conditions. As previously mentioned, pilots can establish their own more stringent rules for the personal, equipment, and environmental conditions that might lead them to decide not to fly on a given day. The FAA Risk Management Handbook (FAA-H-8083-2) has a chapter explaining the rationale for personal minimums in more detail and how to establish and maintain these minimums.

Aeronautical decision-making (ADM) in flight usually involves a systematic mental process pilots use to determine a course of action in response to a given set of circumstances. Pilots should perceive any hazards that threaten the safety of flight, determine a course of action that will lead to a successful outcome, and then perform the steps expected to lead to that successful outcome. The process of hazard perception, situation processing, and performance should repeat as the flight progresses. At the conclusion of a flight the pilot can self-assess on the quality of decision making.

Despite advancement in training methods, airplane equipment and systems, and services for pilots, incidents and accidents still occur. Despite all the changes in technology to improve flight safety, the human factor plays a role in a high percentage of all aviation accidents.

Human factor-related accidents usually do not involve a single decision but result from a chain of decisions and factors that might lead to an accident. An error chain describes the sequence of several events in a human factors-related accident. Breaking one link in the chain would normally change the outcome of the sequence of events.

This list presents different hazards and pilot responses. Did these pilots carefully consider the consequences of their decisions?

- Circumstance: My oxygen system has a slow leak. Decision: Soaring conditions are perfect, and I will not need oxygen for today.
- Circumstance: High winds are forecast later today. Decision: I can fly and make it back before the wind changes.
- Circumstance: My aircraft or radio batteries are low. Decision: I am only planning a short flight, so I'll go.

Circumstances as mundane as a slow oxygen leak, a high wind forecast, or low batteries become part of a decision chain that can lead to an incident or accident. In the previous circumstances, the pilot might interrupt an accident chain by having the slow oxygen leak repaired, respecting the high wind forecast and postponing the flight, or recharging the low batteries before the flight.

Advisory Circular (AC) 60-22, Aeronautical Decision Making, provides introductory material, background information, and reference material on ADM. The material in this AC provides a systematic approach to risk assessment and stress management in aviation, illustrates how personal attitudes can influence decision-making, and how those attitudes can be modified to enhance safety. This AC also provides instructors with methods for teaching ADM techniques and skills in conjunction with conventional flight instruction. Individuals learning to fly gliders should seek out instructors who integrate ADM training. The FAA Risk Management Handbook (FAA-H-8083-2) provides an overview and examples of what pilots do to make their flights safe and enjoyable.

Analysis of Previous Accidents

The National Transportation Safety Board (NTSB) compiles an accident report any time a reportable glider accident occurs. Interested persons can find this public information at www.ntsb.gov.

An individual using the NTSB's accident database, can use their supplied query tool to perform a simple search using the term "glider" (and other optional elements) to retrieve accident reports involving gliders. The detail in these reports provides a narrative of circumstances and events that led to each accident. Since pilot decisions before and during flight may have prevented these accidents, a review can illustrate the concept of an accident chain. That understanding should prompt pilots to make safety and risk mitigation a high priority. *Figure 13-13* contains a summary of several glider accident final reports from the past several years.

Event Date	Glider Type	Injury	Probable Cause
2/9/2020	Aviastroitel AC 4C	Fatal	The pilot's exceedance of the glider's critical angle of attack while maneuvering for landing, which resulted in an aerodynamic stall and subsequent loss of control.
3/1/2020	Let L 23 SUPER BLANIK	Serious	The pilot's failure to maintain glider control and his exceedance of the glider's critical angle of attack while maneuvering in gusting wind conditions, which resulted in an aerodynamic stall.
4/7/2020	Schempp Hirth Standard Cirrus	Fatal	The pilot's exceedance of the glider's critical angle of attack following his premature termination of the tow for reasons that could not be determined, which resulted in an aerodynamic stall/spin during a turn back to the departure airport.
5/11/2020	Schempp Hirth VENTUS 2CT	Minor	A loss of thermal lift during a motor glider flight, which resulted in an off-airport landing. Contributing to the accident was the pilot's delayed attempted engine start.
6/4/2020	Gilasflugel Mosquito	None	The pilot's decision to divert to the private airport and his subsequent failure to maintain directional control while landing on a turf runway that contained tall grass.
6/13/2020	Pipistrel PIPISTREL SINUS 912	None	The pilot's failure to maintain airspeed while landing with a quartering tailwind, which resulted in a loss of control and a hard landing.
7/11/2020	Schleicher ASW27	Fatal	The pilot's loss of glider control while maneuvering near a mountain ridge in downdrafts and dry microbursts at an altitude that precluded recovery.
8/16/2020	Evektor Aerotechnik L13	Serious	The pilot's failure to stow the speed brake prior to attempting takeoff.
9/19/2020	PIK PIK-200	Minor	The pilot's failure to maintain directional control during takeoff that resulted in a collision with another glider that was parked close to the departure runway, and the pilot's improper decision to attempt a takeoff without ensuring he had safe clearance from the parked glider.
9/29/2020	Schleicher ASK21	None	The pilot's improper control input during a bounced landing that resulted in the glider impacting terrain.
11/7/2020	Schleicher ASW20C (A1); Schleicher ASW27 (A2)	Serious	The failure of both pilots of each glider to see an avoid one another while maneuvering, which resulted in a mid-air collision.
12/27/2020	Glasflugel CLUB LIBELLE 205	Serious	The pilot's failure to maintain adequate clearance from trees during an off-airport landing.
4/22/2021	Schempp Hirth Ventus C	Serious	Impact with trees during a forced landing in atmospheric lift conditions that were insufficient to maintain flight. Contributing was the pilot's delayed decision to return to the airport.
5/16/2021	I.C.A. BRASOV (ROMANIA) IS- 2882	Serious	The flight instructor's failure to maintain aircraft control resulting in the exceedance of the glider's critical angle of attack following the breakage of the weak/safety link during a winch launch, which resulted in an aerodynamic stall and spin, and subsequent impact with trees and terrain.
5/20/2021	Pilatus 84-PC11	Minor	The pilot's misjudged approach angle which resulted in impact with trees and terrain.
6/5/2021	Schweizer SGS 2-33A	None	The pilot's failure to maintain directional control while landing in gusting wind conditions.
6/6/2021	Schweizer SGS 1-35	Fatal	The pilot's low-altitude release from tow for reasons that could not be determined, and his subsequent exceedance of the glider's critical angle of attack while returning to the runway, which resulted in an aerodynamic stall and impact with terrain.
6/13/2021	Schweizer SGS 2-33A	Serious	The student pilot's failure to maintain an appropriate glide path to the runway.
6/20/2021	Schweizer SGS 1-35	Minor	The glider pilot's loss of visual references during the landing approach resulting in an offairport landing on rough sloping terrain.
7/15/2021	ALEXANDER SCHLEICHER GMBH & CO ASW 27-18	None	The pilot's failure to maintain the glider's stability in the roll axis during the takeoff roll, which resulted in a dragged wingtip and ground loop.
7/25/2021	BURKHART GROB G 103 TWIN	Minor	The glider's encounter with atmospheric conditions where the lift was not sufficient to maintain flight which resulted in an off-airport landing and a collision with a fence.
8/15/2021	Schweizer SGS 2-33A	None	The check pilot's failure to account for the extended departure distance from the airport during a simulated tow rope break and recovery.
9/7/2021	Aeromot AMT-100	None	The pilot's failure to extend the landing gear.
10/21/2021	Pipistrel Apis-Bee	Serious	The pilot's failure to maintain control of the glider during the landing approach, which resulted in an aerodynamic stall and subsequent impact with the runway.
11/17/2021	PHOENIX AIR U-15 PHOENIX	None	The pilot's failure to maintain distance with an airport sign while taxiing.
4/8/2022	ALEXANDER SCHLEICHER GMBH & CO ASK 21	None	The gliders encounter with atmospheric conditions where the lift was not sufficient to maintain flight and subsequent impact with mountainous terrain.
6/19/2022	ROLLADEN-SCHNEIDER 15-6	None	The glider's encounter with atmospheric conditions where the lift was not sufficient to maintain flight and subsequent water ditching.
6/22/2022	LET L-23 SUPER BLANIK	Serious	The pilot's encounter with sinking air conditions that resulted in a loss of lift and a subsequent loss of control.
6/22/2022	DG FLUGZEUGBAU GMBH DG 10005	None	The glider's encounter with atmospheric conditions where the lift was not sufficient to maintain flight. Contributing to the accident was the pilot's decision to overfly a suitable landing site which resulted in an off-field landing in a lake.
7/10/2022	Schleicher ASW-198	None	The pilot's misidentification of the runway during the visual approach which resulted in an off runway landing and impact with a trailer.

Figure 13-13. *Glider accident data from the NTSB database.*

Chapter Summary

This chapter focuses on the subset of human factors that pilots can control to prevent accidents. Hazardous attitudes play a role in accidents, and pilot should recognize and avoid them and the types of errors they lead to. The chapter discusses human physiology related to glider flight. Pilots should know how to take care of their physical needs before and during flight. The chapter also discusses systems pilots might use during glider flight including oxygen systems. The chapter discusses risk management and reducing the level of risk to avoid accidents. The NTSB database contains accident reports that illustrate the concept of an accident chain. While glider flight has inherent associated risk, the principles discussed in this chapter and throughout this handbook can reduce a glider pilot's level of exposure to that risk.