Surviving After a Forced Landing

Some Statistics:
- 35% survived the initial forced landing
  - 21 were injured, 4 survived the first 24 hours
  - 14 were uninjured, 7 survived after 72 hours

Questions to ask:
- How seriously do I take this?
- Am I prepared for the stresses of survival?

Post-Crash Survival

1. Psychology of survival (i.e. the will to survive)
   - Post-crash survival is 90% mental
   - Must have knowledge of the search-and-rescue system
   - In order of survival value:
     1. Oxygen
     2. Shelter
     3. Rest
     4. Water
     5. Food
   - STOP mnemonic:
     - Sit
     - Think
     - Observe
     - Plan

2. Search and Rescue
   - File a flight plan! (it’s cheap and it works)
   - (121.5Mhz specific) If a VFR flight plan was filed and you are overdue, it will be 2.5 hours into your survival situation before the actual physical search begins (assuming the distress call was not received).
   - Make occasional position reports [to FSS]. This is especially useful on long flights
   - Plan to spend at least a night, post-crash
   - SARSAT takes 2 orbits (3hr 20min) to pinpoint a [121.5Mhz] ELT signal within 11nm.
     - But 406Mhz ELTs are near-instantaneous
   - In general, you will be found 2 days sooner with a functional ELT
• The Air Force Rescue Coordination Center estimates that as many as 12% of ELTs do not activate when they are supposed to
• Leaving your cell-phone on (VFR, and see FAR 91.21(b-5) ) can help search-and-rescue teams

3. Surviving Extreme Environments
• Sweating (See “Danger of Dehydration” handout)
• **Don’t get in the plane thirsty**
• **Hot-land environments**
  • Stay out of the sun
  • Stay off the desert floor (at least 1 foot)
  • Don’t spend energy in the daylight
  • **GET WATER** (see handout on two water-collection methods)
  • Note: Hypothermia *can still occur* when the air temperature is above freezing
• **Cold-land environments**
  • Dress for the external environment (or at least bring appropriate clothing along)
  • 50% of all body heat is lost through the head and neck
  • Stay covered
  • Frost-bite is irreversible
  • Snow-blindness: wear sunglasses
  • Don’t eat snow! Melt it first, then drink it
    i. Otherwise, it can lead to hypothermia
• **Clothing**
  i. Wet clothing in the wind will draw off body heat **20 times faster** than wind alone
  ii. A wool sweater has the greatest insulative capacity
  iii. A wool sweater is the best material for retaining its insulative capacity when wet
• Your clothing will be your most immediate source of shelter

4. First Aid / Self Aid
• **ABC mnemonic** (order of treatment):
  • Airway
  • Breathing
  • Circulation
• The recommended method for opening a person’s airway if it is obstructed is by tilting the head back, or the jaw thrust
• **Give CPR only if you have been trained to**
• Hemorrhage control: Treat quickly and aggressively!
• Types of bleeding
  • Arterial
  • Venous
• Don’t take off saturated bandages! It disrupts the clotting
• Pressure points for bleeding: There are only 12 of them, so learn them
• Only apply a tourniquet as a last resort
  • Mark the time it was applied: you have 2 hours before the extremity below will need blood
**Single-Pilot IFR**

- Single-pilot IFR accounts for more accidents than 2-pilot crews
- 45% of pilots in weather-related accidents were instrument rated

- The main factor: workload (multi-tasking)
  - But there are ways to do it safely: it’s all about priority

- Regulations & Procedures: they take the decision process out

- **SRM** (CRM for single-pilot operations)

1. **Preparation**
   - Set personal minimums
   - Pre-flight (aircraft, weather, route, etc)
   - Known the risks (both present & future)
   - You aren’t really alone (ATC, passengers, etc)

2. **Resource Management**
   - Yourself
   - “Virtual Copilots”
     - Passengers
     - Equipment
       - GPS/FMS
       - **Autopilot** <- The most important piece of equipment
     - Charts, plotters, etc
     - ATC
   - You must know how to use the technology (and their limitations)
   - **In a 2-pilot crew, a re-route is a 2-person job**

3. **Decision Making**
   - Decision making is a continual process
     - Anticipate
     - Recognize
     - Act
     - Evaluate
   - Pay attention and be aware of any changes
   - **Memorize emergency checklists**
     - Talk the procedures out loud to yourself while performing them
   - Situational Awareness: Knowing…
o Where you are
o Where you are going
o How you will get there
o And always have an out
   i. Best to plan this *on the ground*

4. Communication
   • ATC, FSS, Passengers
   • Other pilots

   • Working with ATC
     a. Listen before speaking
     b. Reference position to a local navaid/fix
     c. Make deviation requests early
        i. (i.e. If you hear other aircraft ahead of you on the same route are
taking missed, better to deviate now than wait)
     d. *Know when to say “Stand By”*
     e. **Ask for an initial heading** if you need time to program in a route change

   • Passengers
     o Maintain a sterile cockpit
     o They can help with see-and-avoid
     o Keep them under control

   • Last component of SRM: Yourself!!
     o Know your current proficiency
     o Know your equipment
     o Know your health
     o Stay organized -> Build a “nest” in the cockpit

   • If you fly IFR infrequently, get a 6-month IPC
Stall/Spin Awareness:
What you don’t know CAN hurt you

- Stalls and Spins were first recorded by the Wright brothers in 1912
  - These have been with aviation since the beginning

- FAA-RD-77-26, 09/76: “General Aviation Pilot Stall Awareness Study”

- First rule: fly the plane

- Study: Extra stall training made no difference in accidental stalls
  - Most planes have their stall warning on only one wing and no AOA indicator
    - The other wing could stall first
  - BUT, additional spin training DID decrease accidental spins

- True cause of spins: **Excess yaw @ stall = spin**
  - (The saying “no stall, no spin” is simplistic)
  - Causes of excess yaw:
    - Adverse yaw (ailerons)
    - Torque, p-factor, slipstream (engine)
    - Improper footwork (rudder)

- When flying VFR, trust your senses
  - Stop staring at the ball

- Turn coordinator ball:
  - It has a bank limit (and a small amount of lag)
  - Not the end-all of yaw control, and may not show instantaneous coordination
  - Use the ball for fine-tuning

- Swept-wing planforms:
  - Stalls at the wingtip first, aggressive stall with pitch up, lateral control immediately lost
  - *Excessive yaw can turn a basic rectangle planform wing* (good stall characteristics) **into acting like a swept-wing**

- Spin Recovery (discussed in detail in next topic)
  - Power
  - Ailerons
  - Rudder
  - Elevator
The PARE Procedure

- 2 necessary ingredients for a spin: (1) yaw, (2) stall
  - Sources of yaw: rudder use, adverse yaw, engine effects

- Terms
  - A procedure is “what” needs to be done
  - A technique is “how” it will be done
  - “Elevator Through Neutral” refers to moving the elevator toward which ever way is neutral (direction agnostic)

- In spin recovery, the elevator is the last input to move
- Elevator magnitude of movement depends on whatever it takes to stop whatever is still happening

- Sequential inputs tend to be more effective than simultaneous inputs
- Eliminate power and aileron inputs early
- Rudder followed by elevator is a critical sequence of events

- You can’t do stall recovery while still in a spin!

  Spin Recovery
  1. **Power** <- Off (i.e. to idle)
  2. **Ailerons** <- Neutral, Flaps up (if they were down)
  3. **Rudder** <- FULL opposite to yaw direction, BE ABRUPT!
     - Put the other foot on the floor to ensure that you are using full opposite rudder
  4. **Elevator** <- Through neutral (Not before rudder application, but don’t wait until rotation is finished)
  5. Hold the above inputs until rotation stops!
     a. Spin recovery may time TIME and ALTITUDE

- Once the spin is done
  1. Rudder <- Neutral
  2. Elevator <- Easy pull, back to straight-and-level

- Turn Coordinator ball is useless in a spin
  - The needle/airplane will be wing-low in the direction of the spin (upright spins only)

- The “Hands Off” (Beggs method)
- Not always as good as the NASA “PARE” method
- It might also not work at all

- **Spin Physiology**
  1. Channelization of sensory inputs (similar to “target fixation”)
  2. Inability to judge the passage of time
  3. Limited control of muscular inputs (e.g. freezing at the controls)
  4. VOD (vestibulo-ocular disorganization) – i.e. disorientation

- Most aircraft have a one-turn spin margin of error
- Most spin-approved aircraft will outlast the pilot’s physiological limit
  - Spin will appear to speed up at the physiological limit, when really it is stabilizing: this is VOD

- Once recovered from a prolonged spin, post-rotatory nystagmus or vestibular sensations can fool the pilot into re-entering a spin

- *All types of spins have the same recovery method* (PARE)
Single-Pilot Flying Strategies

- If you’re working hard at flying, you’re probably doing it wrong

- Cockpit wisdom comes from understanding our human nature
  - Understanding & recognizing external pressures
  - What compels us to act

- Aircraft today are easier to fly, but not to operate

- We don’t fly “all-weather” aircraft
- We don’t have airline-like training
  - Or any of the other resources they have (dispatchers, copilot, etc)

**We are not a scheduled airline!**

- **Biggest single-pilot concerns**
  - Workload  
    - Talking to yourself can help
  - The 2 most important things in aviation…are the next 2 things
    - Be proactive, not reactive

- Verbal Checklists:
  1. Horizontal Movement
     - Where am I?
     - Where am I going?
     - How do I get there?
  2. Vertical Movement
     - How low?
     - How long?
     - Which way?
  3. Nav Equipment
     - See it
     - Say it
     - Check it

- “Stand By”  
  - The two most important words to learn

- Getting ATIS: Ask the controller if you can go off frequency for 3 minutes to get the ATIS. If being vectored, you can ask the controller for the ATIS
- Routing changes: See “Single Pilot IFR”; ask for an initial heading

- Asking ATC when they are busy:
  - Ask questions that only require a yes or no answer

- Tell ATC what you need:
  - You can ask for anything you need/want

- Ask ATC/FSS to explain/define
  - (e.g. weather VOR references, etc)

- **Use your “time machine”**
  - If you need time [to think], slow down (but notify ATC)

- NASA study -> For single-pilot flying, a single-axis (wing-leveler) autopilot is the best. Multi-axis autopilots tend to remove the pilot from being mentally engaged
Managing Your Engine for Peak Performance

- Avoid engine starts (when possible)
- Lean aggressively
- Have as few thermal cycles as possible
- High MP/low RPM

- Don’t keep pre-heaters plugged in all the time if the temperature swings above/below freezing: this can lead to condensation
- Don’t pull the prop through if you’re not going flying
- Don’t run the engine for 20 minutes if you aren’t going flying

**Lycoming service instruction**
- Don’t lean above 75%
  - <=75% power: lean to 50* ROP
  - <=65% power: lean to peak regardless of altitude

- Note max CHT
  - Continental: 400*F, Stay below 460*F redline
  - Lycoming: 425*F, Stay below 500*F redline
  - CHTs between 350*F and 380*F in cruise
  - Oil Temp of 180*F in cruise

- Lean for all ground taxi operations
  - No permanent damage can be done on the ground by over-leaning (though the engine may stop if leaned too much)

- Engine monitors are great diagnostic tools, and pay for themselves

- 125*F ROP = Best power
  - Good for high-and-hot takeoff operations
- 45*F LOP = Best economy

- Minimize heat up & cool down cycles

- **No part-throttle takeoffs**
  - We should ignore engine-life concerns during takeoff
  - Make the climb from “V1” to 1000’ AGL as quickly as possible

- Reducing power (variable-pitch prop): Reduce 2” MP in 2 minutes
  - Equates to ~50*F CHT/minute
• Use cowl flaps to control CHTs

• Any power setting in the POH is an approved setting
• Consider the accuracy of the tach and MP gauge
• Engine actually likes over-square MP/RPM
  o Propeller operates better at low RPMs
  o Of course, any turbo-charged engine will be operated over-square
  o Many POHs actually list over-square settings
  o HP loss to friction is lower at lower RPMs

• Fly frequently
• See hand-out for 6 tools for determining engine health