XIII.B. Systems and Equipment Malfunctions

References: FAA-H-8083-3; POH/AFM

Objectives
The student should develop knowledge of the elements related to emergency procedures and be able to explain the proper procedures for certain situations based on the PTS.

Key Elements
1. Understand the Problem
2. Follow the Checklist
3. Safety of Those Onboard

Elements
1. Smoke, Fire, or both, during Ground or Flight Operations
2. Rough Running Engine or Partial Power Loss
3. Loss of Engine Oil Pressure
4. Fuel Starvation
5. Engine Overheat
6. Hydraulic Malfunction
7. Electrical Malfunction
8. Induction Icing
9. Door or Window Opening In Flight
10. Inoperative or “Runaway” Trim
11. Flap malfunction
12. Pressurization Malfunction

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 has the ability to understand problems and why they may occur in the airplane. The student also can properly react to the emergency situations that have been discussed in a timely manner.
Instructors Notes:

Introduction:
Attention
Interesting fact or attention grabbing story
Wouldn’t it be fun to be flying one day and experience a problem that you have no idea how to deal with? Of course not, that’s why it’s important to understand your equipment and the proper procedures associated.

Overview
Review Objectives and Elements/Key ideas

What
Systems and equipment malfunctions involves knowing how to handle problems that may occur in the airplane in order to provide as safe a flight as possible.

Why
The key to successful management of an emergency situation, and/or preventing a non-normal situation from progressing into a true emergency, is a thorough knowledge of, and adherence to, the necessary procedures.

How:
1. Smoke, Fire, or Both, During Ground or Flight Operations
   A. In-Flight Smoke/Fire - In any fire, it is essential the source is discovered first
      i. Engine Fire
         a. Usually caused by a failure allowing a combustible substance to contact a hot surface
         b. Checklist
            - Shut off the fuel supply to the engine
            - Fuel Shut-Off Valve: CLOSED
            - Cabin Heat: CLOSED
         c. If the flames are put out, do not attempt to restart the engine
         d. Perform an emergency landing
         e. Keep in mind that
            - There may be severe structural damage and control could be lost at any time
            - The airplane may still be on fire and susceptible to explosion
            - The airplane is expendable and the only thing that matters is the safety of those onboard
      ii. Electrical Fires
         a. Indication is usually the distinct odor of burning insulation
         b. Checklist
            - GEN/BAT Master: OFF
            - Cabin Air: OPEN
            - Fire Extinguisher: Use only if smoke development continues
         c. If the fire is extinguished and electric power is required to continue the flight:
            - Avionics Master: OFF
            - Electrically Powered Equipment: OFF
            - Restore electrical power systematically allowing time to monitor the system voltmeter and amp meter—Watch carefully for smoke
### XIII.B. Systems and Equipment Malfunctions

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<tbody>
<tr>
<td>a</td>
<td>Circuit Breakers: PULL ALL</td>
<td>f</td>
<td>Circuit Breakers: Push AVIONICS &amp; AVIONICS MASTER</td>
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<tr>
<td>b</td>
<td>Circuit Breakers: PUSH BATTERY</td>
<td>g</td>
<td>Avionics Master: ON</td>
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<td>c</td>
<td>GEN/BAT Master: ON BAT (½ only)</td>
<td>h</td>
<td>Circuit Breakers: Activate systems as required</td>
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<td>d</td>
<td>Circuit Breakers: Push GEN &amp; GEN CONTROL</td>
<td>i</td>
<td>Radio: ON</td>
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<tr>
<td>e</td>
<td>GEN/BAT Master Switch: ON</td>
<td>j</td>
<td>Land ASAP</td>
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#### d. Try to identify the faulty circuit by checking circuit breakers, lights, instruments, and avionics
- If it cannot be detected, the battery master switch and generator should be turned off
- However, any materials which have been ignited may continue to burn

#### e. If there is smoke in the cockpit, open the windows

### iii. Cabin Fires

- Usually result from:
  - Careless smoking on the part of the pilot and/or passengers
  - Electrical system malfunctions
  - Heating system malfunctions

- Two immediate demands:
  - Attacking the fire
  - Getting the airplane safely on the ground as quickly as possible

- Checklist
  - GEN/BAT Master: OFF
  - Cabin Heat: CLOSED
  - Fuel Shutoff Valve: CLOSED
  - Cabin Air: OPEN
  - Mixture: IDLE CUTOFF
  - Fire Extinguisher: As Required
  - Land ASAP
  - Evacuate Immediately

### B. Ground Smoke/Fire

#### i. Engine Fire/Smoke

- Checklist
  - Fuel Shutoff Valve: CLOSED
  - Cabin Heat: CLOSED
  - Mixture: IDLE CUTOFF
  - GEN/BAT Master: OFF
  - Ignition: OFF
  - Evacuate Immediately

#### ii. Electrical Fire/Smoke

- If smoke in the cabin indicates an electrical fire, immediately turn off the master switch
- Checklist
  - GEN/BAT Master: OFF
  - In Engine is running
  - Throttle: IDLE
  - Mixture: IDLE CUTOFF
  - Fuel Shutoff Valve: CLOSED
  - Ignition: OFF
  - Canopy: OPEN
  - Fire Extinguisher: As Required

### 2. Rough Running Engine or Partial Power Loss

#### A. Checklist

- Mixtures: FULL RICH
- Alternate Air: OPEN
- Fuel Shutoff: OPEN
- Fuel Pump: ON
- Ignition: CYCLE, L - BOTH - R – BOTH
- Throttle: AT PRESENT POSITION
- If no improvement, reduce the throttle to minimum required power and land ASAP

#### B. High Oil Pressure

- Possible Cause - Cold oil or possible internal plugging
- Corrective Action - If cold, allow the engine to warm, if not, reduce power and land ASAP
B. Low Oil Pressure
   i. Possible Cause - Broken Pressure Relief Valve, Insufficient Oil, Burned Out Bearings
   ii. Corrective Action - Land ASAP or feather the prop and stop engine
C. Checklist
   i. Oil Temp: CHECK
   ii. If Pressure drops below Green Arc but Temp is normal: LAND AT NEAREST FIELD
   iii. If Pressure drops below Green Arc and Temp is rising: REDUCE THROTTLE TO MIN REQ POWER
      a. Be prepared for engine failure and emergency landing

4. Fuel Starvation
   A. Normally indicated by a rough running engine, and can be caused by an blocked lines or empty tanks
   B. Check the fuel flow gauge
   C. Fuel Shutoff: OPEN
   D. Mixture: FULL RICH
   E. Electric Fuel Pump: ON
      i. Check the fuel flow gauge again

5. Engine Overheat
   A. The oil temperature gauge is the primary instrument in determining if the engine is overheating
   B. Causes and Corrective Action

<table>
<thead>
<tr>
<th>POSSIBLE CAUSES</th>
<th>CORRECTIVE ACTION</th>
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<tbody>
<tr>
<td>Low Oil</td>
<td>Reduce Power. Land ASAP</td>
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<tr>
<td>Oil Congealed in Cooler</td>
<td>Reduce Power. Land. Preheat Engine</td>
</tr>
<tr>
<td>Inadequate Engine Cooling</td>
<td>Reduce Power, Increase AS</td>
</tr>
<tr>
<td>Detonation or Preignition</td>
<td>Check Cylinder Head Temps/Enrich Mixture/Reduce MP</td>
</tr>
<tr>
<td>Obstruction in the Oil Cooler</td>
<td>Reduce Power. Land ASAP</td>
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<tr>
<td>Damaged or Improper Baffle Seals</td>
<td>Reduce Power. Land ASAP</td>
</tr>
<tr>
<td>Defective Gauge</td>
<td>Reduce Power. Land ASAP</td>
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6. Hydraulic Malfunction
   A. If the hydraulic pump were to fail, there are manual means to raise/lower the gear
      i. Some airplanes will automatically lower the gear (DA42)

7. Electrical Malfunction
   A. The generator/alternator is the cause of most electrical system failures (indicated on the ammeter)
      i. Once the generator goes offline, the only electrical source remaining is the battery
         a. The battery although may have very little time available
   B. Electrically powered gear and flaps use up power at rates much greater than most other equipment
      i. Selecting these motors on a partially depleted battery could result in immediate loss of power
   C. Steps
      i. Turn off all but the most necessary electrical equipment
         a. Save as much power as possible
      ii. Notify ATC immediately and request vectors for a landing at the nearest airport
      iii. Expect to make a no flap landing, and anticipate a manual gear extension
   D. Checklist
      i. Total Electrical Failure
         a. Battery Circuit Breaker: RESET, if tripped
         b. GEN/BAT Master: check ON
         c. Master Switch: OFF if power not restored
         d. If unsuccessful, land at the nearest suitable airport
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ii. Generator Failure (GEN. Annunciator Light Illuminated)
   a. GEN/BAT Master: Cycle Generator Master Switch OFF - ON
   b. Generator Circuit Breaker: RESET, if tripped
   c. Generator Control Breaker: RESET, if tripped
   d. If GEN cannot be brought online: Switch off all non-flight essential electrical consumers
      - Monitor the Ammeter and Voltmeter
      - Land at the nearest airport

iii. Low Voltage Indication (Needle in yellow arc) While on the Ground
   a. Engine RPM: Increase RPM until needle is in the Green Arc (Should occur before 1100 RPM)
   b. Non-Flight Essential Electrical Consumers: Switch OFF consumers until in the Green Arc
   c. If needle remains in the yellow arc, and the ammeter is indicating left of center (discharge),
      discontinue any flight activity
   d. Low Voltage Indication (needle in yellow arc) While in the Air
      - Non-Flight Essential Electrical Consumers: OFF
      - If needle stays in the yellow arc, and the ammeter indicates a discharge, use GEN FAILURE

8. Induction Icing
   A. As air is ingested through the engine intakes, the moisture can freeze inside the induction system,
      reducing or stopping the flow of combustible air to the engine
      i. Ice can also form on the exterior of the airplane, and clog the air intake openings
   B. Corrective Action
      i. Use the Alternate Air source
   C. Icing Checklist
      i. Leave icing area (change altitude or flight direction to reach a higher temp)
      ii. Continue to move the control surfaces to maintain mobility
      iii. Alternate Air: ON
      iv. Increase RPM to avoid icing of prop blades
      v. Cabin Heat: ON DEFROST

9. Door or Window Opening In Flight
   A. In the event of an inadvertent door opening in flight or on takeoff, adhere to the following:
      i. Concentrate on flying the plane, an open door seldom compromises the ability of the plane to fly
      ii. Do not rush to land the plane if the door opens during lift off
         a. Climb to normal pattern altitude, fly a normal pattern, make a normal landing
      iii. Don’t release the seatbelt to attempt to reach the door, leave the door alone, land, then close it
      iv. Most doors will not stay open, they will usually bang open then settle partially closed
         a. A slip toward the door may open it wider, and a slip away may push it closed

10. Inoperative or “Runaway” Trim
    A. Checklist
       i. Control Stick: Grip stick and maintain control of the airplane
       ii. Trim Motor Circuit Breaker: PULL the breaker
       iii. Rocker Switch: Check if depressed
    B. If the reason for the runaway trim is obvious and has been resolved, engage the breaker

11. Flap Malfunction
    A. Total Flap Failure
       i. This will necessitate a no flap approach and landing
          a. This will require substantially more runway than normal (as much as 50% more)
          b. The airplane must be flown in a relatively nose-high attitude as compared to flaps extended
             - This can make the runway difficult to see
c. A wider, longer pattern may be necessary to avoid diving to lose altitude and building up airspeed
d. The airplane will tend to float considerably during roundout
ii. If only flaps are unavailable, raise the approach airspeed 10 knots and maintain a flat approach angle

B. Asymmetric (Split) Flap
i. A situation in which one flap deploys/retracts while the other remains in position
ii. The problem is indicated by a pronounced roll toward the wing with the least flap deflection
iii. Countering
   a. Countered with opposite aileron
   b. The yaw caused by the additional drag on the extended flap side will require opposite rudder
      • Aileron and opposite rudder results in a crossed control situation
   c. Almost full aileron may be necessary at the reduced airspeed to maintain wings level
      • Therefore, do not attempt to land with a cross-wind from the side of the deployed flap
         a. The additional roll control to counteract the cross-wind may not be available
   iv. Be aware of the differing stall speeds of each wing
      a. The wing with the retracted flap will stall much earlier - possible crossed control stall condition
   v. Approach and landing should be flown at a higher than normal airspeed

12. Pressurization Malfunction
   A. Descend or use supplemental oxygen,
      i. Hypoxia is the primary danger of decompression

Conclusion:
Brief review of the main points
Understanding different emergencies and how to deal with them is obviously important as you will always be prepared and be able to react quickly in the event one of these emergencies occurs.

PTS Requirements:
To determine that the applicant exhibits instructional knowledge of at least five (5) of the equipment malfunctions, appropriate to the airplane used for the practical test by describing recommended pilot action for:
   1. Smoke, fire, or both, during ground or flight operations.
   2. Rough running engine, or partial power loss.
   3. Loss of engine oil pressure.
   4. Fuel starvation.
   5. Engine overheat.
   7. Electrical malfunction.
   8. Carburetor or induction icing.
   9. Door or window opening in flight.
   10. Inoperative or “runaway” trim.
   11. Landing gear or flap malfunction.