

## **XIII.B. Systems and Equipment Malfunctions**

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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	<ol style="list-style-type: none"><li>1. Understand the Problem</li><li>2. Follow the Checklist</li><li>3. Safety of Those Onboard</li></ol>
Elements	<ol style="list-style-type: none"><li>1. Smoke, Fire, or both, during Ground or Flight Operations</li><li>2. Rough Running Engine or Partial Power Loss</li><li>3. Loss of Engine Oil Pressure</li><li>4. Fuel Starvation</li><li>5. Engine Overheat</li><li>6. Hydraulic Malfunction</li><li>7. Electrical Malfunction</li><li>8. Induction Icing</li><li>9. Door or Window Opening In Flight</li><li>10. Inoperative or "Runaway" Trim</li><li>11. Flap malfunction</li><li>12. Pressurization Malfunction</li></ol>
Schedule	<ol style="list-style-type: none"><li>1. Discuss Objectives</li><li>2. Review material</li><li>3. Development</li><li>4. Conclusion</li></ol>
Equipment	<ol style="list-style-type: none"><li>1. White board and markers</li><li>2. References</li></ol>
IP's Actions	<ol style="list-style-type: none"><li>1. Discuss lesson objectives</li><li>2. Present Lecture</li><li>3. Ask and Answer Questions</li><li>4. Assign homework</li></ol>
SP's Actions	<ol style="list-style-type: none"><li>1. Participate in discussion</li><li>2. Take notes</li><li>3. Ask and respond to questions</li></ol>
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:**

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**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
      - Cabin Heat: CLOSED
      - Airspeed: 73 knots
      - Fuel Pump: OFF
      - a Fuel Shut-Off Valve: 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

a	Circuit Breakers: PULL ALL	f	Circuit Breakers: Push AVIONICS & AVIONICS MASTER
b	Circuit Breakers: PUSH BATTERY	g	Avionics Master: ON
c	GEN/BAT Master: ON BAT (½ only)	h	Circuit Breakers: Activate systems as required
d	Circuit Breakers: Push GEN & GEN CONTROL	i	Radio: ON
e	GEN/BAT Master Switch: ON	j	Land ASAP

- 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
    - a 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

- a. Usually result from:
  - Careless smoking on the part of the pilot and/or passengers
  - Electrical system malfunctions
  - Heating system malfunctions
- b. Two immediate demands:
  - Attacking the fire
  - Getting the airplane safely on the ground as quickly as possible

c. Checklist

• GEN/BAT Master: OFF	• Cabin Heat: CLOSED
• Cabin Air: OPEN	• Fire Extinguisher: As Required
a If smoke increases, close immediately – possible fire in heating system/baggage	• Land ASAP

B. Ground Smoke/Fire

i. Engine Fire/Smoke

a. Checklist

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

ii. Electrical Fire/Smoke

- a. If smoke in the cabin indicates an electrical fire, immediately turn off the master switch
- b. Checklist

• GEN/BAT Master: OFF	
• In Engine is running	
a Throttle: IDLE	d Ignition: OFF
b Mixture: IDLE CUTOFF	e Canopy: OPEN
c Fuel Shutoff Valve: CLOSED	f Fire Extinguisher: As Required

2. Rough Running Engine or Partial Power Loss

A. Checklist

i. Mixture: FULL RICH	v. Ignition: CYCLE, L - BOTH - R – BOTH
ii. Alternate Air: OPEN	vi. Throttle: AT PRESENT POSITION
iii. Fuel Shutoff: OPEN	vii. If no improvement, reduce the throttle to minimum required power and land ASAP
iv. Fuel Pump: ON	

3. Loss of Engine Oil Pressure

A. High Oil Pressure

- i. Possible Cause - Cold oil or possible internal plugging
- ii. Corrective Action - If cold, allow the engine to warm, if not, reduce power and land ASAP

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- 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

POSSIBLE CAUSES	CORRECTIVE ACTION
Low Oil	Reduce Power. Land ASAP
Oil Congealed in Cooler	Reduce Power. Land. Preheat Engine
Inadequate Engine Cooling	Reduce Power, Increase AS
Detonation or Preignition	Check Cylinder Head Temps/Enrich Mixture/Reduce MP
Obstruction in the Oil Cooler	Reduce Power. Land ASAP
Damaged or Improper Baffle Seals	Reduce Power. Land ASAP
Defective Gauge	Reduce Power. Land ASAP

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 | c. Master Switch: OFF if power not restored              |
| b. GEN/BAT Master: check ON                   | d. If unsuccessful, land at the nearest suitable airport |

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

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- 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.
6. Hydraulic malfunction.
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.
12. Pressurization malfunction.