

1. Engine Failure (Single/Multi-Engine)

Overview

An engine failure, whether on a single-engine or multi-engine aircraft, requires prompt diagnosis and rapid action to maintain control and maximize the chances of a safe landing. Engine failure can occur due to mechanical issues, fuel contamination, or other system malfunctions. In multi-engine aircraft, asymmetrical thrust must be managed, while in single-engine aircraft, the pilot must immediately transition into glide mode.

Symptoms

- **Loss of Engine Power:**
 - A sudden drop in engine revolutions per minute (RPM).
 - Indications that fuel flow has dropped to zero.
- **Abnormal Vibrations or Noises:**
 - Unusual shaking or oscillations that may signal mechanical distress.
 - Audible changes in engine tone, such as sputtering or chugging.
- **Fire Warnings or Smoke:**
 - Activation of fire detection systems.
 - Visible smoke or odor of burning material.

Immediate Actions

- **Aviate:**
 - **Maintain Aircraft Control:** Focus first on controlling the aircraft. Adjust pitch to achieve best glide speed, ensuring that the aircraft remains stable.
- **Troubleshoot Engine Controls:**
 - **Fuel Selector:** Verify that it is in the "ON" position.
 - **Mixture Control:** Set to "RICH" to ensure an adequate fuel-to-air ratio.
 - **Ignition Switch:** Cycle the switch to reset the ignition system.
 - **Throttle Adjustment:** Modify throttle position as necessary to attempt to regain engine power.

Restart Procedure

- **Fuel Pump:**
 - Turn on the fuel pump to supply fuel to the engine.
- **Engine Restart:**
 - Follow your aircraft's specific checklist to attempt a restart.
 - Monitor engine instruments carefully to verify that power is returning.

Declaration of Emergency

- **Squawk 7700:**
 - Transmit a squawk code of 7700 on your transponder to signal an emergency.
- **MAYDAY Call:**
 - Communicate the emergency status clearly over the appropriate radio frequencies.

Checklist and Securing Procedures

- **Engine Failure Checklist:**
 - Confirm the status of fuel systems, electrical systems, and ignition controls.
- **Engine Securing (if required):**
 - Once it is determined that the engine cannot be restarted, shut it down properly:
 - Turn the fuel valve to “OFF.”
 - Feather the propeller (if applicable) to reduce drag and minimize further damage.
- **Landing Preparations:**
 - Identify and prepare a suitable site for an emergency landing.
 - Advise passengers of the situation and prepare them for impact if needed.

Additional Considerations

- **Landing Site Selection:**
 - Prioritize landing areas that are open and free of obstacles.
 - Avoid densely populated regions or areas with difficult terrain.
 - **Communications:**
 - Keep air traffic control (ATC) informed.
 - Provide clear instructions to cabin crew and passengers.
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2. Fire/Smoke in Cockpit/Cabin

Overview

A fire or the presence of smoke in the cockpit or cabin represents an immediate threat to the safety of everyone onboard. The source can be electrical, engine-related, or related to cargo. Quick identification and suppression of the fire are critical to minimize damage and potential injury.

Symptoms

- **Visible Flames or Smoke:**

- Fire may be seen in the cockpit, cabin, or engine compartment.
- Smoke might be visible even if flames are not.
- **Burning Smell:**
 - Distinct odor of burning materials.
- **Warning Lights:**
 - Activation of fire detection and suppression system alerts.

Immediate Actions

- **Don Oxygen Masks:**
 - Both crew and passengers should put on oxygen masks immediately to prevent smoke inhalation.
 - Utilize smoke goggles if available.
- **Identify the Source:**
 - Quickly determine if the fire is originating from electrical systems, the engine compartment, or cargo areas.
- **Use Fire Extinguisher:**
 - Locate and deploy the appropriate fire extinguisher (typically HALON or CO₂).
 - Aim at the base of the flames for effective suppression.
- **Land as Soon as Possible:**
 - Declare an emergency, squawk 7700, and prepare for an immediate landing.

Checklist

- **Fire Suppression Checklist:**
 - For electrical fires, turn off the master switch if it is safe to do so.
 - For engine fires, cut off fuel and ignition supplies before applying the extinguisher.
 - For cabin fires, ventilate the cabin and isolate the affected area.

Additional Considerations

- **Smoke Evacuation:**
 - Utilize procedures such as partially opening windows or vents if safe to help clear the smoke.
- **Passenger Evacuation:**
 - Begin preparations for a potential emergency evacuation once on the ground.

3. Loss of Cabin Pressure (Rapid Decompression)

Overview

Rapid decompression can occur due to structural failures or breaches in the pressurized cabin. It poses an immediate risk of hypoxia to both crew and passengers. Swift action is required to restore a safe environment and perform an emergency descent if necessary.

Symptoms

- **Loud Bang and Fogging:**
 - A sudden explosive sound accompanied by fog or condensation in the cabin.
- **Oxygen Mask Deployment:**
 - Automatic deployment of oxygen masks indicates a loss of pressure.
- **Ear Discomfort:**
 - Passengers and crew may experience ear pain or temporary hearing loss due to rapid pressure changes.

Immediate Actions

- **Don Oxygen Masks:**
 - Ensure that all crew and passengers immediately secure their oxygen masks.
- **Emergency Descent:**
 - Initiate an emergency descent to reach a safe altitude (typically below 10,000 feet MSL) as quickly as possible.
- **Communicate:**
 - Inform ATC of the emergency and declare a squawk 7700.

Checklist

- **Cabin Pressure Checklist:**
 - Confirm the status of the pressurization system (ensure it is in “MANUAL” mode if automatic controls are compromised).
 - Cross-check the cabin altitude with the oxygen supply system.
 - Monitor for any signs of hypoxia among passengers and crew.

Additional Considerations

- **Hypoxia Risks:**
 - Prioritize a rapid descent over waiting for explicit ATC clearance if hypoxia is imminent.
 - **Post-Landing Procedures:**
 - Ensure that all occupants undergo a medical check following landing.
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4. Landing Gear Malfunction

Overview

Landing gear malfunctions can jeopardize a safe landing. Common issues include failure of gear extension, false indications, or abnormal vibrations during the approach. Quick assessment and remedial actions are essential.

Symptoms

- **Gear Warning Horn:**
 - Activation of a horn or audible alert that signals a gear malfunction.
- **Unsafe Gear Indication:**
 - Visual or physical indicators suggest that the gear is not fully deployed.
- **Abnormal Vibrations:**
 - Unusual vibrations during the approach may indicate mechanical issues with the gear.

Immediate Actions

- **Recycle Landing Gear:**
 - Attempt to extend the gear using the standard and emergency extension procedures (manual or hydraulic systems).
- **Low Pass for Visual Confirmation:**
 - Request that ATC provide a low-altitude visual check of the gear status.
- **Prepare for a Gear-Up Landing:**
 - If the gear remains unresponsive, prepare the aircraft and occupants for a gear-up landing:
 - Dump fuel if required (following proper procedures).
 - Secure the cabin and instruct passengers on brace positions.

Checklist

- **Landing Gear Emergency Extension Checklist:**
 - Follow the aircraft's checklist to manually extend the landing gear.
- **Fuel Dumping Procedure:**
 - If applicable, follow procedures to dump fuel safely to reduce landing weight.

Additional Considerations

- **Runway Preparation:**
 - Alert ground crews to foam the runway if available to minimize friction or fire risk.
 - **Post-Landing Evacuation:**
 - Prepare for immediate evacuation due to the potential for a post-landing fire.
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5. Severe Weather (Thunderstorms/Icing)

Overview

Severe weather events such as thunderstorms or icing conditions pose significant challenges, including turbulence, hail damage, and engine performance issues. Early avoidance and the activation of anti-icing systems are critical.

Symptoms

- **Turbulence and Hail:**
 - Sudden, severe turbulence; potential impact from hail.
- **Lightning:**
 - Electrical disturbances or lightning strikes that may temporarily disrupt systems.
- **Ice Accumulation:**
 - Formation of ice on wings, engines, and control surfaces.
- **Airspeed Uncertainty:**
 - In icing conditions, the accuracy of airspeed indicators may be compromised.

Immediate Actions

- **Divert Course/Avoidance:**
 - Change course to avoid the severe weather. Request an altitude change if it will help in evading the storm.
- **Activate Anti-Ice Systems:**
 - Turn on wing and engine anti-ice systems immediately.
- **Adjust Speed:**
 - Reduce to turbulence penetration speed to mitigate the impact of sudden gusts or changes in airflow.

Checklist

- **Severe Weather Checklist:**
 - Ensure that pitot heat is turned on to prevent icing of the airspeed sensors.
 - Disengage the autopilot if turbulence is severe to allow manual control.
 - Verify that all passenger seatbelts are fastened securely.

Additional Considerations

- **Monitor for Carburetor Icing:**
 - Particularly in piston-engine aircraft, carburetor icing may occur; adjust engine settings accordingly.
- **Radar Use:**

- Utilize onboard weather radar to avoid embedded thunderstorms and other hazardous weather phenomena.
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6. Bird Strike

Overview

Bird strikes can occur at various phases of flight, particularly during takeoff and landing. Impacts can damage windshields, engines, and other critical systems. Immediate post-strike assessment is essential to determine subsequent actions.

Symptoms

- **Loud Impact Noise:**
 - A distinct, loud noise may be heard at the moment of impact.
- **Engine Surge/Flameout:**
 - Engines may experience a sudden surge or complete flameout due to bird ingestion.
- **Windshield Damage:**
 - Cracks or chips on the windshield that may affect visibility.

Immediate Actions

- **Assess Damage:**
 - Quickly inspect engine performance, instruments, and flight controls for abnormalities.
- **Follow Engine Restart Procedures:**
 - If an engine has flamed out, follow the restart checklist and attempt to restart it as per the aircraft manual.
- **Prepare for Immediate Landing:**
 - Declare an emergency and inform ATC; prepare for landing as soon as possible.

Checklist

- **Bird Strike Checklist:**
 - Check all instruments for abnormal readings.
 - Secure the cockpit by removing any loose debris.

Additional Considerations

- **Windshield Integrity:**
 - If cracks are noted, reduce airspeed to minimize further stress on the windshield.

- **Avoid Further Hazards:**
 - Alter your route to avoid areas with high bird activity, such as bodies of water or known migration paths.
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7. Medical Emergency (Passenger/Crew)

Overview

Medical emergencies onboard, whether affecting passengers or crew, can range from minor ailments to life-threatening conditions. The crew must be prepared to provide first aid, use onboard medical kits, and, if necessary, divert to the nearest airport.

Symptoms

- **Severe Medical Symptoms:**
 - Unconsciousness, chest pain, seizures, or other distress signals from a passenger or crew member.
- **Declared Distress:**
 - Any announcement of a medical emergency requiring immediate intervention.

Immediate Actions

- **Request Medical Assistance:**
 - Identify any onboard medical professionals who can provide first aid or advanced care.
- **Prepare for Diversion:**
 - Coordinate with ATC to divert to the nearest suitable airport where full medical services are available.
- **Use Emergency Medical Kit (EMK):**
 - Administer oxygen, medications, or use defibrillators as required.

Checklist

- **Medical Emergency Checklist:**
 - Communicate with ground-based medical services to arrange for assistance.
 - Ensure that the defibrillator and other critical medical equipment are prepared for use.

Additional Considerations

- **Declare PAN-PAN:**

- Use the PAN-PAN call for urgent but non-life-threatening situations. Transition to MAYDAY if the situation escalates.
 - **Cabin Crew Briefing:**
 - Instruct cabin crew on the procedure for assisting the affected individual(s) and managing passenger behavior.
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8. Electrical Failure

Overview

Electrical failures can lead to loss of critical flight instruments and systems. It is essential to preserve the functionality of basic flight instruments and to attempt restoration of power while preparing for a potential emergency landing if necessary.

Symptoms

- **Loss of Instruments/Avionics:**
 - Critical flight instruments (attitude, altitude, airspeed) may go dark or behave erratically.
- **Dim or Flickering Lights:**
 - Cockpit or cabin lighting may become unstable.
- **Warning Lights:**
 - Indications such as “GEN OFF” or “BAT DISCHARGE” may be present.

Immediate Actions

- **Prioritize Essential Instruments:**
 - Focus on maintaining attitude, altitude, and airspeed readings using standby or backup instruments.
- **Attempt Circuit Reset:**
 - Reset alternator or generator (GEN) switches as appropriate to restore power.
- **Declare Emergency if Needed:**
 - If the power cannot be restored and essential systems are compromised, declare an emergency by squawking 7700.

Checklist

- **Electrical Failure Checklist:**
 - Cross-check and rely on standby instruments.
 - Conserve battery power by turning off all non-essential electrical loads.

Additional Considerations

- **Manual Procedures:**
 - Prepare for manual operation of systems such as landing gear extension if electronic systems fail.
 - **Alternate Communications:**
 - Utilize handheld radios or backup communication methods to maintain contact with ATC.
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9. Fuel Emergency

Overview

A fuel emergency occurs when fuel levels are critically low, or when fuel supply issues affect engine performance. Prompt identification and immediate actions are necessary to ensure the aircraft can safely reach a landing location.

Symptoms

- **Low Fuel Warnings:**
 - Electronic alerts and cockpit indications of fuel levels reaching critical thresholds.
- **Engine Sputtering:**
 - Engines may begin to sputter or exhibit signs of power loss due to insufficient fuel.

Immediate Actions

- **Declare Emergency:**
 - Clearly announce "MAYDAY, fuel critical" to ATC.
- **Optimize Fuel Usage:**
 - Adjust the mixture to a lean setting if appropriate and reduce altitude to optimize fuel efficiency.
- **Plan Immediate Landing:**
 - Identify the nearest suitable airport for an emergency landing, even if that airport requires an off-field landing procedure.

Checklist

- **Fuel Emergency Checklist:**
 - Confirm the available fuel quantity, checking crossfeed valves and gauge readings.
 - Calculate the remaining glide range and plan the descent accordingly.

Additional Considerations

- **ATC Coordination:**
 - Work closely with ATC to obtain vectors for the shortest and safest route to an airport.
 - **Engine-Out Procedures:**
 - Be prepared to operate the aircraft in an engine-out configuration if necessary.
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10. Hijacking/Security Threat

Overview

In the event of a hijacking or other security threat, the priority is to maintain control of the aircraft while following established security protocols. Communication must be discreet, and the crew should avoid confrontation while ensuring the safety of all onboard.

Immediate Actions

- **Squawk 7500:**
 - Immediately set the transponder to squawk 7500, the internationally recognized hijack code.
- **Comply with Intruder Instructions:**
 - Follow any direct instructions from the hijacker to avoid escalating the situation.
- **Discreet Communication:**
 - Use secure communication channels such as ACARS or discreet notes to inform ATC of the situation without alerting the hijacker.

Checklist

- **Security Threat Checklist:**
 - Ensure the cockpit door is locked and secure.
 - Follow any national or airline-specific security protocols designed for hijacking situations.

Additional Considerations

- **Safe Landing:**
 - Coordinate with ATC to land at a predetermined safe airport.
 - **Activate ELT:**
 - If circumstances demand, activate the Emergency Locator Transmitter (ELT) to assist rescue operations.
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General Emergency Protocols

Key Points

- **MAYDAY Call:**
 - Use the MAYDAY call when the situation is immediately life-threatening. Repeat the call three times, stating the nature of the emergency and your intentions.
- **Memory Items:**
 - Rely on memorized, critical steps such as “Aviate, Navigate, Communicate” which should be second nature to all crew members.

Post-Emergency Procedures

- **Aircraft Inspection:**
 - Once the aircraft is safely on the ground, perform a thorough inspection for damage.
 - **Incident Reporting:**
 - File a comprehensive incident report. For example, use the NASA ASRS (Aviation Safety Reporting System) or other relevant channels as mandated by regulations.
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11. Emergency Descent Procedures

11.1 Overview

An emergency descent is a controlled maneuver designed to rapidly lower the aircraft's altitude in situations such as sudden cabin depressurization or an uncontrollable onboard fire. The primary objective is to reach an altitude below 10,000 feet MSL quickly, where supplemental oxygen is not mandatory, thus mitigating hypoxia risks.

11.2 Preparation

- **Don Oxygen Masks:**
 - Immediately secure oxygen masks for the entire crew and, if possible, advise passengers to do the same.
- **Notify ATC:**
 - Inform air traffic control of the emergency descent, providing your current altitude and the intended descent profile.
- **Review Descent Profile:**

- Familiarize yourself with the specific descent profile for your aircraft. This profile is influenced by aircraft performance characteristics, regulatory requirements, and environmental conditions.

11.3 Descent Profile (Sample Diagram Overview)

Below is an ASCII diagram representing a generic emergency descent profile. Note that times and flight levels are exemplary and should be adjusted based on the actual aircraft and conditions.

Altitude (FL)	Time Interval (min)
FL350	2.5
FL280	7.0
FL200	21.0
FL100	51.0
FL050	...

- **Explanation:**
 - **FL350 to FL280:** Initial rapid descent using maximum allowable descent rate.
 - **FL280 to FL200:** Continue descent with gradual deceleration as the aircraft approaches denser air.
 - **FL200 to FL100:** Leveling off briefly may be required to manage airspeed and structural stress.
 - **FL100 to FL050 and below:** Final approach to a safe altitude (typically below 10,000 feet MSL) where supplemental oxygen is no longer mandatory.

11.4 Considerations for Emergency Descent

- **Standard Atmospheric Conditions:**
 - If flying above the transition level, the descent is based on the standard atmosphere.
- **Local Altimeter Settings:**
 - When operating below the transition level, adjust for local QNH and temperature variations to ensure an accurate altitude reading.
- **Time Management:**
 - The profile durations provided (e.g., 2.5, 7, 21, 51 minutes) are examples. Actual descent times depend on aircraft performance, weight, and regulatory escape criteria.
- **Terrain Awareness:**

- Always consider the surrounding terrain and potential obstacles. If flying in a mountainous or urban area, further modify the descent profile accordingly.