

CHAPTER 6 EMERGENCY FLOWS AND CHECKLISTS

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General

This chapter contains Bridgewater State University procedures for handling various emergencies while operating the Piper PA28R200 Arrow. The procedures are based on and in some cases expand on the manufacturer's procedural recommendations, as well as the guidance provided in the AIM.

Use of Emergency Checklists

Emergency checklist flows of this chapter ...

~ shall be accomplished from memory. ~

Although the completion of tasks will follow a specified sequence, some actions will be performed nearly simultaneously. Time and situation permitting, the accomplished flow tasks shall be verified with the printed checklist in-hand.

It is absolutely essential that pilots rehearse these procedures to achieve and maintain the expected level of proficiency. Due to rapid nature of emergencies it is critical that the emergency flows be accomplished from memory, accurately and efficiently, as the situation may not allow the time to either refer to a paper checklist or to correct any mistakes.

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ENGINE FAILURE / POWER LOSS

The following section contains checklists and SOPs addressing engine failures in various situations. Not all situations can be predicted or addressed by checklists. In all cases, the AFM guidance and FAA regulations must be followed, and solid PIC judgment exercised.

ENGINE FAILURE and POWER LOSS, DEFINED

Engine failure / power loss can be defined as one or more of the following:

- Complete engine failure (propeller windmills or even stops if airspeed is extremely low, engine is relatively quiet and develops no power)
- Partial engine failure (engine runs and develops limited power well below normal levels)
- Loud noises and/or vibration from an engine with apparent total or partial power loss (may indicate a bad, randomly firing magneto, detonation due to incorrect grade of fuel, or other mechanical failure)
- Extreme engine vibration (may indicate a failed propeller blade and must be treated differently from a typical engine failure – see Propeller Blade Failure Emergency procedure in this chapter)

Regardless, all partial engine failure/power loss situations should be treated as either full or imminent engine failures. A partial engine failure is likely to be followed by a complete engine failure in a short time period, and the safest course of action is to assume that it will happen.

In the following procedures, the words “failure” and “power loss”, as related to an engine, shall be used interchangeably, to mean either full or partial (imminent) engine failure.

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CONTROL FLOW (ABCD flow / engine failure in-flight SOP)

NOTE

Whenever the engine fails (completely or partially), the first and foremost goal is establishing and maintaining aircraft control at best glide airspeed. At low altitudes, any other course of action other than a relatively straight descent to a landing may be impossible. Reducing the pitch and an accompanying descent **MUST** be accepted to maintain best glide airspeed.

This CONTROL FLOW SOP is the foundation of engine-out procedures and must be performed from memory, immediately and without hesitation when engine power loss is experienced.

The steps following this SOP, such as troubleshooting, restart and forced landing/ditching, depend on a particular situation and will be addressed in the individual emergency procedures.

WARNING

While this SOP is written sequentially, some steps occur and must be executed nearly simultaneously for best possible outcome. For example, turning on the fuel pump is a critical step, and, if appropriate to the situation, there will be enough time to accomplish it even if there may be no time / altitude remaining for other actions.

So, the pilot, experiencing an engine failure would, simultaneously, immediately turn on the fuel pump, establish best glide, and proceed to the best field, with the remaining actions appropriate to the situation and time/altitude available.

CONTROL FLOW (engine failure in-flight immediate action SOP)

<u>A</u>IRSP<u>E</u>E<u>D</u>	BEST GLIDE
▶ POSITIVELY PITCH for V_g and MAINTAIN	COMPLETE
▶ TRIM (if prolonged flight at V_g)	BEST GLIDE PITCH ATTITUDE
<u>B</u>EST F<u>E</u>I<u>E</u>L<u>D</u>	HEAD TOWARDS
▶ DESCENT AT BEST GLIDE	ACCEPTED
▶ SAFE BANK ANGLE	MAINTAINED
<u>C</u>HECKLIST	CONSIDER / EXECUTE
(evaluate if ground contact is imminent, runway remains, or landing)	
▶ FUEL PUMP (AS SOON AS POSSIBLE)	ON
▶ FLAPS	AS REQUIRED
<u>D</u>ECL<u>A</u>R<u>E</u>	EMERGENCY
▶ ATC / OTHER A/C / 121.5 / TRANSPONDER / ELT	AS REQUIRED

**CONTROL FLOW (engine failure in-flight immediate action SOP),
EXPANDED**

AIRSPEED BEST GLIDE

If uncommanded full or partial power reduction is detected, or other indications of either complete or partial power loss of the engine appear, achieve and maintain best glide airspeed.

▶ **POSITIVELY PITCH for V_G and MAINTAIN COMPLETE**

If at airspeeds above V_G , initially hold level pitch and allow the airplane to slow down to V_G . If at airspeed at or below V_G , such as during climb, apply as much forward pressure as necessary on the yoke to achieve and maintain V_G . The changes in control pressures may be significant.

▶ **TRIM (if prolonged flight at V_G) BEST GLIDE PITCH ATTITUDE**

Unless ground contact is imminent and if continued flight at V_G is anticipated, TRIM for BEST GLIDE PITCH ATTITUDE, to minimize pilot workload during subsequent steps. Once the trim is set, only small adjustments to pitch attitude and control pressures will be required to maintain V_G .

BEST FIELD HEAD TOWARDS

Head towards the best landing field that safety considerations and situation allows. It does not mean a radical turn if one is inadvisable. The best field may be a patch of clear ground straight ahead during very low altitude engine failures, even though there is a runway behind you. In the same spot over the ground, an aircraft at a safely higher altitude could consider turning for the runway, which would then become the best field. A particular situation and all available options must be considered.

▶ **DESCENT AT BEST GLIDE ACCEPTED**

Accept that a descent at best glide cannot be avoided and must be maintained until touchdown flare is initiated, regardless of the field chosen.

▶ **SAFE BANK ANGLE MAINTAIN**

Maintain safe bank angles while maneuvering. Remember that stall speed increases as bank angle increases. Maintain coordination, except in those situations where intentional forward slip at a safe airspeed becomes necessary to land in the available emergency landing area.

CHECKLIST CONSIDER / EXECUTE

(evaluate if ground contact is imminent, runway remains, or landing)

Consider if time and situation allow for a checklist flow execution, which checklist to execute, and then execute the appropriate checklist flow by memory. Evaluate if ground contact is imminent or sufficient runway is available for landing and decision is made to land immediately. Time permitting, backup the performed emergency flow with the checklist in hand.

▶ **FUEL PUMP (AS SOON AS POSSIBLE) ON**

If the engine failure is due to insufficient fuel pressure or failure of the engine driven fuel pump, the simple action of turning the fuel pump ON may restore engine power. With the aircraft under positive control at best glide airspeed, perform this step if appropriate to the situation. This step is critical and takes only moments to

accomplish, *and must be performed as soon as possible (immediately following the engine failure).*

► **FLAPS AS REQUIRED**

When established on a heading toward the best available field, immediately evaluate flap requirements. During high altitude engine failures when prolonged glide is desired, flaps will typically not be used until necessary for landing. However, in certain cases, when the best and only appropriate field is straight ahead, the approach is clearly high and a turn is inadvisable, flaps may be used immediately to land in the available landing area distance. With the aircraft under positive control at best glide airspeed, perform this step if appropriate to the situation.

DECLARE EMERGENCY

With the aircraft under control, declare your emergency so that priority and assistance can be received, both during and after the landing. Especially after a survivable approach in an inhospitable terrain, it is critical that someone comes looking for you as soon as possible. Declaring your emergency while still in the air will avoid situations where no one knows that you are in need of assistance, and so no one comes looking. Do not rely on the automatic ELT activation alone, rather, view the ELT as a backup only to the pilot emergency declaration action.

► **ATC / OTHER A/C / 121.5 / TRANSPONDER / ELT AS REQUIRED**

Use the most appropriate and complete means of declaring an emergency. At a towered airport, or when in two-way communications with any ATC facility, this could be as simple as transmitting to the tower / ATC. Outside of ATC communications, over terrain or at a non-towered airport, especially at night, other means must be used including contacting other a/c, transmitting on 121.5, activating the transponder on 7700 and, if landing off airport, activating the ELT.

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ENGINE FAILURE ON RUNWAY

▶ **AIRCRAFT CONTROL** **MAINTAIN**
THROTTLE **CLOSED**
STOP **STRAIGHT AHEAD**

- IF INADEQUATE RUNWAY REMAINS -

BRAKING **MAXIMUM**
MIXTURE **IDLE CUT-OFF**
MASTER SWITCH **OFF**
MAGNETOS **OFF**
FUEL SELECTOR **OFF**
STOP **AFTER AVOIDING OBSTACLES**
▶ **AIRCRAFT** **EVACUATE**

ENGINE FAILURE ON RUNWAY, EXPANDED

▶ **AIRCRAFT CONTROL** **MAINTAIN**
The first priority is to maintain aircraft control. The goal is to bring the aircraft to a safe stop, preferably on the runway, while avoiding any obstacles.

THROTTLE **CLOSED**
Reduce the throttle to idle immediately once decision to abort has been made.

STOP **STRAIGHT AHEAD**
Stop on the remaining runway by utilizing brakes as appropriate to the remaining runway length and condition.

- IF INADEQUATE RUNWAY REMAINS -

Evaluate if stopping on the remaining runway is possible.
If any doubt exists, perform the following steps.

BRAKING **MAXIMUM**
Apply maximum effective braking to stop in the shortest possible distance.

MIXTURE **IDLE CUT-OFF**
Continue securing the engine by moving the mixture all the way back to IDLE CUT-OFF.

MASTER SWITCH **OFF**
Turn the electrical master switch OFF to minimize risk of electrical spark from energized electrical system.

MAGNETOS **OFF**
Continue securing the engine by moving the IGNITION key to the OFF position, which will turn the MAGNETOS OFF.

FUEL SELECTOR.....OFF

Turn the FUEL SELECTOR OFF (depress the safety latch first) to cut the fuel at the source and thus minimize the risk of fire.

STOP..... AFTER AVOIDING OBSTACLES

Use steering as necessary to avoid any obstacles while bringing aircraft to a stop in shortest possible distance.

► AIRCRAFT..... EVACUATE

Without unnecessary delay, evacuate the aircraft when it is safe to do so.

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ENGINE FAILURE IN-FLIGHT

AIRSPEEDBEST GLIDE
BEST FIELD HEAD TOWARDS
CCHECKLIST..... CONSIDER / EXECUTE
DECLARE.....EMERGENCY

- IF SITUATION PERMITS -

ENGINE TROUBLESHOOT IN-FLIGHT Checklist..... (as appropriate) EXECUTE

- IF LANDING IS IMMINENT -

ENGINE SECURE IN-FLIGHT Checklist (as required) EXECUTE

**ENGINE FAILURE IN-FLIGHT,
EXPANDED**

In the following steps, perform the CONTROL FLOW SOP as discussed earlier in this chapter.

WARNING

Maintain best glide airspeed and aircraft coordination at all times while performing flows/checklists and maneuvering for a landing.

If obstacles are encountered in the last moments before touchdown, they can be avoided provided the aircraft has sufficient airspeed.

Trying to stretch the glide by increasing the pitch beyond what is required to maintain best glide will result in increased rate of descent and, eventually, a stall and uncontrolled descent into terrain.

CONTROL FLOW SOP

AIRSPEEDBEST GLIDE
BEST FIELD HEAD TOWARDS
CCHECKLIST MEMORY FLOW CONSIDER / EXECUTE
DECLARE.....EMERGENCY

- IF SITUATION PERMITS -

This is a general guideline only. Not all situations can be foreseen. Best glide airspeed must be achieved and adhered to, regardless. In general, with aircraft safely under control at best glide airspeed, engine troubleshooting and restart attempt should be considered, situation, time and altitude permitting.

ENGINE TROUBLESHOOT IN-FLIGHT Checklist.....(as appropriate) EXECUTE

IF the decision is made to attempt to revive the inoperative engine, when time and situation permits, perform the ENGINE TROUBLESHOOT IN-FLIGHT Checklist.

CAUTION

These are general guidelines only. The decision to troubleshoot rests entirely with the PIC, depending on the actual situation, regardless of altitude.

- IF LANDING IS IMMINENT -

These are general guidelines only. Not all situations can be foreseen. In general, when departing a runway during engine power loss shortly after rotation and during initial climb, a straight ahead landing will be inevitable. Best glide airspeed must be achieved and adhered to. Doing so will provide the airplane with maximum glide distance, allow a landing under control on whatever available surface, and the best outcome. There may also be just be enough time to recognize the failure and turn on the fuel pump. Doing so may restore the power prior to ground contact.

ENGINE SECURE IN-FLIGHT CHECKLIST (as required) EXECUTE

When it is determined that a touchdown is inevitable and the pilot is committed to a course of action, maintain aircraft control and secure the engine, time and situation permitting, to minimize the risk of fire should the aircraft become damaged after touchdown.

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ENGINE TROUBLESHOOT IN-FLIGHT

- ▶ **AIRCRAFT CONTROL** **MAINTAIN**
- FUEL PUMP** **ON**
- FUEL SELECTOR** (feel for detent) **SWITCH TANKS**
- ALTERNATE ENGINE AIR SOURCE** **ON**
- MIXTURE** **FULL RICH**
- PROPELLER** **FULL FORWARD**
- THROTTLE** **OPEN HALF WAY**
- ▶ **ENGINE / FUEL SYSTEM GAUGES** **CHECK**
- MAGNETOS (try EACH SINGLE magneto)** **CYCLE L / R / BOTH**
- ▶ **STARTER (if prop is stopped)** **ENGAGE**
- ▶ **THROTTLE and MIXTURE** **TRY DIFFERENT SETTINGS**
- IF ENGINE POWER NOT RESTORED -**
- ENGINE SECURE IN-FLIGHT Checklist** **EXECUTE**

ENGINE TROUBLESHOOT IN-FLIGHT, EXPANDED

- ▶ **AIRCRAFT CONTROL** **MAINTAIN**
The first priority is to maintain aircraft control while performing any flows and checklists. Consider the safest course of action for the flight outcome before spending time troubleshooting.

FUEL PUMP **ON**
 Turn the fuel pump ON immediately and leave it on. If the engine failure is due to insufficient fuel pressure or failure of the engine driven fuel pump, the simple action of turning the fuel pump ON may restore engine power.

FUEL SELECTOR **(feel for detent) SWITCH TANKS**
 Switch the FUEL SELECTOR to the OTHER TANK containing fuel, and make sure it is securely engaged in the detent. Be extremely careful not to switch the fuel selector accidentally to the off position.

CAUTION

Do not expect power to be restored immediately upon switching tanks, even if the new tank contains fuel and has no mechanical abnormalities. Allow the engine to windmill and monitor the situation, as appropriate.

If the engine failure was caused by water in the fuel, it may take some time to be used up, and allowing the engine to windmill may restore power.

If the engine failure was caused by fuel exhaustion, power will not be restored after tanks are switched until empty fuel lines are filled, which may require up to 10 (ten) seconds.

ALTERNATE ENGINE AIR SOURCE OPEN

Turn ON the alternate air control for the engine, by moving the lever to OPEN position. This will open the alternate air door and allow unfiltered air from around the engine to be mixed with fuel, thus possibly restoring power to the engine, if the failure was due to primary air source blockage, and the failure of the door to open automatically.

MIXTURE FULL RICH

Check that the mixture is FULL RICH (full forward).

PROPELLER..... FULL FORWARD

Move the propeller lever to FULL FORWARD, MAXIMUM RPM position.

THROTTLE OPEN HALF-WAY

Set the throttle to approximately HALF-WAY open position, to allow air to enter the engine for possible restart.

▶ **ENGINE / FUEL SYSTEM GAUGES..... CHECK**

Check engine and, specifically, fuel system gauges for indications of the cause of power loss. In particular, no fuel pressure indication may imply power loss due to exhausted fuel supply. Recheck the fuel selector position to be sure it is on the tank containing fuel. Normal fuel pressure indication with no power may imply power loss due to water in fuel.

MAGNETOS (try EACH SINGLE magneto)..... CYCLE L / R / BOTH

It is possible for one bad magneto to disable the engine despite the second remaining good magneto. Try cycling the engine magnetos to eliminate bad magneto as a possible cause for the power loss. First, check that both magnetos are ON, with the ignition switch on BOTH. Then, turn the ignition key to the LEFT MAGNETO (L). If power is not restored, turn the ignition key to the RIGHT MAGNETO (R). If power is not restored, turn the ignition key back to BOTH.

If the engine begins to run with the ignition switch in either L or R position, leave the switch in that position and do not move it again until after flight is terminated.

▶ **STARTER (if prop is stopped) ENGAGED**

If the propeller is stopped, which may occur at very low airspeeds, crank the engine to allow the engine shaft to turn and the propeller to windmill, which is a pre-requisite for a successful engine restart.

▶ **THROTTLE and MIXTURE TRY DIFFERENT SETTINGS**

If previous steps do not restore power and if time permits, try different throttle and mixture setting combinations. This may restore power if the problem is too rich or too lean a mixture, or partial fuel system restriction.

- IF ENGINE POWER NOT RESTORED -

If all troubleshooting attempts have failed to restore engine power and it is advantageous to discontinue further troubleshooting attempts and secure the engine, perform the following step(s).

ENGINE SECURE IN-FLIGHT Checklist.....EXECUTE

If troubleshooting attempts have failed to restore the power, or if time and situation preclude completion of engine troubleshoot, perform the ENGINE SECURE IN-FLIGHT Checklist.

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ENGINE SECURE IN-FLIGHT

► **AIRCRAFT CONTROL** **MAINTAIN**

FUEL SELECTOR **OFF**
FUEL PUMP **OFF**

ALTERNATE ENGINE AIR **OFF**
MIXTURE **IDLE CUT-OFF**
THROTTLE **CLOSED**
MAGNETOS **OFF**
FORCED LANDING / DITCHING CHECKLIST **EXECUTE**

**ENGINE SECURE IN-FLIGHT,
EXPANDED**

► **AIRCRAFT CONTROL** **MAINTAIN**

The first priority is to maintain aircraft control while performing any checklists or flows. Consider the safest course of action for the flight outcome before securing the engine.

FUEL SELECTOR **OFF**
 Turn the FUEL SELECTOR to OFF (depress the safety latch first) to cut the fuel at the source and thus minimize the risk of fire on landing.

FUEL PUMP **OFF**
 Turn the FUEL PUMP switch to OFF position to prevent fuel from entering the secured engine.

ALTERNATE ENGINE AIR **OFF**
 Turn OFF the alternate air control for the engine by moving the lever to CLOSED position.

MIXTURE **IDLE CUT-OFF**
 Move the mixture all the way aft to IDLE CUT-OFF to cut the fuel supply to the engine.

THROTTLE **CLOSED**
 Move the throttle lever all the way aft to fully CLOSED position.

MAGNETOS **OFF**
 Turn the IGNITION switch to OFF. This turns off (grounds) both magnetos and cuts the spark to the engine.

FORCED LANDING / DITCHING CHECKLIST **EXECUTE**
 Execute the appropriate Forced Landing or Ditching checklist flow, as time allows and situation requires.

FIRES and EMERGENCY DESCENT

ENGINE FIRE IN-FLIGHT

▶ AIRCRAFT CONTROL	MAINTAIN
FUEL SELECTOR	OFF
MIXTURE	IDLE CUT-OFF
THROTTLE	CLOSED
MAGNETOS	OFF
FUEL PUMP	OFF
CABIN HEAT and DEFROST	CLOSED

EMERGENCY DESCENT (SOP)**..... (as required) **EXECUTE

ENGINE FIRE IN-FLIGHT, EXPANDED

▶ **AIRCRAFT CONTROL** **MAINTAIN**
Maintain positive aircraft control while securing the engine and, altitude permitting, preparing for emergency descent, followed by emergency approach and landing.

FUEL SELECTOR **OFF**
 Turn the FUEL SELECTOR OFF (depress the safety latch first) to cut the fuel at the source and thus stop the fuel from flowing to the fuel pump.

MIXTURE..... **IDLE CUT-OFF**
 Move the mixture to IDLE CUT-OFF (full aft) position to cut the fuel supply to the engine.

THROTTLE **CLOSED**
 Reduce throttle to full aft, CLOSED position to minimize combustion airflow to the engine.

MAGNETOS **OFF**
 Turn the IGNITION switch to OFF. This turns off both magnetos and cuts the spark to the engine.

FUEL PUMP **OFF**
 Turn the fuel pump OFF to prevent additional fuel from entering the engine.

CABIN HEAT and DEFROST **CLOSED**
 Turn the cabin heat and defrost off by moving both levers to CLOSED position, to reduce/prevent the smoke from entering the cabin.

EMERGENCY DESCENT (SOP)** (as required) **EXECUTE
 If altitude and situation permit and the fire is not extinguished, immediately execute Emergency Descent SOP to create an incombustible mixture and expedite putting out the fire, then execute appropriate Forced Landing or Ditching checklist flow as soon as possible.

EMERGENCY DESCENT (SOP)

Emergency descent is a course of action elected by the PIC in situations where rapid loss of altitude and landing as soon as practical is desired, such as during a fire, serious passenger health condition or other emergencies.

EMERGENCY DESCENT (SOP)

THROTTLEIDLE
PROPELLER..... (as required) FULL FORWARD
MIXTURE (if with engine power, or simulating emergencies)..... (as required) RICH
LANDING GEAR (as required) UP
FLAPS UP
 ► **MODERATE BANK** (as required) INITIATE
AIRSPEED INCREASE

EMERGENCY DESCENT (SOP), EXPANDED

THROTTLEIDLE

Reduce the throttle to IDLE to minimize thrust, if with engine power, or when simulating emergencies.

PROPELLER (as required) FULL FORWARD

Set the propeller to FULL FORWARD to maximize braking effect of the propeller drag, or as required.

MIXTURE (if with engine power, or simulating emergencies) (as required) RICH

When performing an emergency descent with engine power, or when simulating emergencies, set the mixture to RICH to ensure smooth engine operation during and after the descent. In an actual emergency, such as engine fire, where the mixture lever has been intentionally set to IDLE CUT-OFF, be careful not to accidentally move the mixture lever and possibly restart the fire.

LANDING GEAR..... (as required) UP

In situations requiring maximum increase in airspeed, check that the landing gear is UP. Consider bringing / leaving the gear down to increase drag and descent rate without additional airspeed increase, if appropriate to the situation.

FLAPS..... UP

In situations requiring maximum increase in airspeed, check that the flaps are UP. If the flaps are down, bring them up in increments during initial stages of the descent.

► **MODERATE BANK** (as required) INITIATE

Situation, terrain and altitude permitting, consider using a moderate bank to clear the descent area and to increase the descent rate due to increased load factor without additional airspeed increase.

AIRSPEED(as required) INCREASE

Pitch down to increase the airspeed to Va or Vno, whichever is less (maximum airspeed during simulated emergencies), or the airspeed appropriate to the situation (during actual emergencies). If the goal of the emergency descent is to put out engine fire, highest safe airspeed will provide the best chance of creating an incombustible air/fuel mixture.

ENGINE FIRE ON THE GROUND

- IF ENGINE HAS NOT STARTED -

MIXTURE..... IDLE CUT-OFF
 THROTTLE..... FULL OPEN
 STARTER ENGAGE/CONTINUE CRANKING
 FUEL PUMP OFF
 FUEL SELECTOR OFF

▶ *EVACUATION (after a few seconds) COMPLETE*

- IF ENGINE HAS STARTED -

MIXTURE..... IDLE CUT-OFF
 THROTTLE..... FULL OPEN
 FUEL PUMP OFF
 FUEL SELECTOR OFF

▶ *EVACUATION (after a few seconds) COMPLETE*

AIRCRAFT EVACUATE

ENGINE FIRE ON THE GROUND, EXPANDED

- IF ENGINE HAS NOT STARTED -

If the engine has not started and there are signs of engine fire, perform the following steps. Continue cranking the starter, as the following few seconds will determine if the fire can be drawn back into the engine. Consult POH / AFM.

MIXTURE..... IDLE CUT-OFF
 Move the mixture to IDLE CUT-OFF (full aft) position to cut the fuel supply to the engine/

THROTTLE..... FULL OPEN
 Open throttle (FULL FORWARD) to allow maximum airflow to reach the engine and attempt to draw the fire into the engine.

STARTER ENGAGE and CONTINUE CRANKING
 Engage cranking of the starter and HOLD key in the START position, continuously cranking the engine to try to draw the fire into the engine.

FUEL PUMP OFF
 Turn OFF the electric fuel pump switch to prevent more fuel from reaching the fire.

FUEL SELECTOR OFF
 Turn the FUEL SELECTOR OFF (depress the safety latch first) to cut the fuel at the source and thus stop the fuel from flowing to the fuel pump.

► **EVACUATION (after a few seconds) COMPLETE**

Evaluate the results and if the fire is not out within a few seconds, immediately evacuate the aircraft and obtain external assistance.

- **IF ENGINE HAS STARTED** -

If the engine has started and there are signs of engine fire, perform the following steps, simultaneously attempting to draw the fire back into the engine and cutting off further fuel supply to the engine. Consult POH / AFM.

MIXTURE IDLE CUT-OFF

Move the mixture to IDLE CUT-OFF (full aft) position to cut the fuel supply to the engine

THROTTLE FULL OPEN

Open throttle (FULL FORWARD) to allow maximum airflow to reach the engine and attempt to draw the fire into the engine.

FUEL PUMP OFF

Turn OFF the electric fuel pump switch to prevent more fuel from reaching the fire.

FUEL SELECTOR OFF

Turn the FUEL SELECTOR OFF (depress the safety latch first) to cut the fuel at the source and thus stop the fuel from flowing to the fuel pump.

► **EVACUATION (after a few seconds) COMPLETE**

Evaluate the results and if the fire is not out within a few seconds, immediately evacuate the aircraft and obtain external assistance.

AIRCRAFT EVACUATE

Even if the fire appears to be out, expedite evacuating the aircraft and obtaining external assistance on the chance that the fire may restart and continue.

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WING FIRE IN-FLIGHT

BEACON / LDG / TAXI / NAV / STROBES OFF
PITOT HEAT OFF
SIDESLIP.....FLAMES AWAY FROM CABIN / FUEL TANK

**WING FIRE IN-FLIGHT,
EXPANDED**

ALL LIGHT SWITCHES OFF

Turn off ALL lights and electrical switches associated with electrical wiring in the wings, to eliminate a source of ignition to the fire.

PITOT HEAT OFF

Turn off the PITOT HEAT switch to eliminate a potential source of ignition to the fire.

SIDESLIP FLAMES AWAY FROM CABIN / FUEL TANK

Sideslip the airplane to keep the flames away from the cabin and the fuel tank, if possible. Consider the possibility and practicality of Emergency Descent, if time and situation permit. Remember this memory aid when executing a sideslip, to help decide on the slip direction: **“STEP ON THE FIRE”**. By stepping on the rudder toward the wing on fire, the slip will be initiated in the opposite direction, thus keeping the fire away from the cabin.

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CABIN ELECTRICAL FIRE or SMOKE IN-FLIGHT

MASTER SWITCH OFF
 ALL ELECTRICAL SWITCHES (as required) OFF
 CABIN AIR VENTS.....(as required) OPEN
 CABIN HEAT and DEFROST OFF
 FIRE EXTINGUISHER..... (as required) ACTIVATE
 NEAREST AIRPORT DIVERT IMMEDIATELY
 ► EMERGENCY DESCENT (as required) EXECUTE

CABIN (when fire is out) VENTILATE
 ► LAND AS SOON AS POSSIBLE

WARNING

Due to lack of electrical power upon completion of this procedure, the gear will have to be deployed manually using Emergency Gear Extension procedures, and gear position lights will not be operative.

Consult POH / AFM and Abnormal Procedures chapter of this FSM.

CABIN ELECTRICAL FIRE or SMOKE IN-FLIGHT, EXPANDED

MASTER SWITCH OFF
 Immediate action must be taken if smoke and/or flames are visible in the cabin. The most likely fire source in the cabin would be the electrical system. Turn both sides of the Master switch OFF if it has been determined that the electrical system has likely caused the fire.

ALL ELECTRICAL SWITCHES (as required) OFF
 Turn all electrical switches to OFF position if the source of fire is undetermined, or as required by the situation. Leave the magnetos / ignition switch ON.

CABIN AIR VENTS (as required) OPEN
 Open the cabin vents to maximize air ventilation available from outside the cabin. However, if, in PIC judgment, opening the vents will feed fresh oxygen to the fire, close the vents, as appropriate.

CABIN HEAT and DEFROST OFF
 Turn the cabin heat and defrost off by moving both levers to CLOSED position, to reduce / prevent the air from entering the cabin from the engine compartment.

FIRE EXTINGUISHER..... (as required) ACTIVATE
 Determine the source of fire and activate the fire extinguisher, as appropriate.

WARNING

Execute an immediate landing at the nearest suitable airport. Accomplish appropriate emergency procedures, but do not delay the landing.

NEAREST AIRPORT..... DIVERT IMMEDIATELY

Immediately divert to the nearest suitable airport to terminate the flight as soon as possible. Do not delay further action. Situations involving smoke and fumes in the cockpit are known to deteriorate extremely fast if immediate action is not taken. Do not risk worsening or restarting the fire by delaying, or turning on the electrical equipment if the flight and the emergency can be concluded safely without it.

► **EMERGENCY DESCENT (as required) EXECUTE**

If the situation is deteriorating and the decision is made to put the aircraft down on the ground as quickly as possible for safety, initiate the Emergency Descent SOP as described in this chapter. This action may be necessary if the fire cannot be controlled.

CABIN (when fire is out)..... VENTILATE

Ventilate the cabin of smoke, fumes and fire extinguisher discharge once it is determined that the fire is out. Open the cabin air vents to bring in fresh air. Open the cabin door if necessary. In any event, take appropriate action to provide breathable air.

► **LAND AS SOON AS POSSIBLE**

While it is desirable to land at an airport, there may be situations where a forced off-airport landing must be considered for the safest outcome for the aircraft occupants, as previously discussed.

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OFF-AIRPORT LANDINGS

In the situations where a forced landing/ditching situation becomes necessary, *the flight crew must accept that an off-airport landing is required, that this is a real situation, and that it is happening NOW.* Doing so in a decisive manner clarifies the tasks at hand and reduces the risk of denial of the situation, resultant poor planning, and an unsuccessful / unsurvivable outcome. The crew should broadcast the situation (“squawk and talk”) and enlist support from ATC, company dispatch, or other aircraft, as appropriate to the situation.

WARNING

In a situation where a forced landing/ditching is deemed the only available option, the FIRST AND ONLY PRIORITY IS THE SAFETY AND SURVIVABILITY OF THE OCCUPANTS.

NOTE

In forced landing situations, the choice to extend the landing gear, if one is available, or land gear-up should be based on the local conditions. If landing on a firm or rough surface, the landing gear can be extended to provide increased shock absorption.

Although the landing gear may be sheared off in a rough area (e.g. a furrowed or rocky field), forward momentum can be dissipated further from the flight crew/passengers via the landing gear rather than through the airframe.

If landing on a very soft, marshy surface or on water, landing with the gear up reduces the risk of the aircraft “digging in” and possibly overturning during touchdown.

FORCED LANDING

▶ **ENGINE** (as required) **SECURE**
RADIO (ATC/121.5) TRANSMIT “MAYDAY”
TRANSPONDER 7700
ELT (if off airport)..... **ACTIVATE**
LOOSE ITEMS **SECURE**
SEATBELTS..... **SECURE**
LANDING GEAR (as required) **DOWN** or **UP**
FLAPS..... (as required) **DOWN** or **UP**
MASTER SWITCH (on final approach)..... **OFF**

- WHEN LANDING IS ASSURED, PRIOR TO TOUCHDOWN -
CABIN DOOR..... **UNLATCHED**
▶ **AIRCRAFT** **EVACUATE**

**FORCED LANDING,
EXPANDED**

- ▶ **ENGINE** (as required) **SECURE**
If forced landing is conducted due to a previous emergency and engine power is not available, ensure that the engine is secure in accordance with the Engine Secure In-Flight Checklist or Engine Fire In-Flight Checklist, as appropriate.
- ▶ *With aircraft under control, declare your emergency so that priority and assistance can be received, both during and after the landing. Especially after a survivable approach in an inhospitable terrain, it is critical that someone comes looking for you as soon as possible. Declaring your emergency while still in the air will avoid situations where no one knows that you are in need of assistance, and so no one comes looking.*
- ▶ *Some of the steps below presume electrical power is available, as it would be after Engine Secure In-Flight Checklist. In situations after Engine / Electrical Fire In-Flight Checklists, electrical power may not be available. The PIC shall make a determination for the best course of action and weigh the risks. The Master Switch then could be activated momentarily to use the radio, etc., and then turned off, if appropriate. Alternatively, the landing could be continued without reactivating the electrical system, if, in PIC judgment, there is risk of restarting the fire.*

RADIO (ATC/121.5) TRANSMIT **“MAYDAY”**

At a towered airport, or when in two-way communications with any ATC facility, transmit your emergency to the tower / ATC using accepted terminology (Refer to AIM). Outside of ATC communications, over terrain or at a non-towered airport, especially at night, transmit on 121.5, contact other a/c, etc.

TRANSPONDER **7700**

Activating the transponder on 7700 will alert any ATC facility having monitoring capabilities that there is an aircraft in distress, and could serve as the means of alerting ATC if radio communication is not possible.

ELT (if off airport)..... **ACTIVATE**

If landing off airport, activate the ELT with the remote switch on the aircraft panel, if installed. Do not rely on the automatic ELT activation alone, but rather view the ELT as a backup only to the pilot emergency declaration action. Even if electrical power is not available, the ELT can still be activated with the switch, and may be the only available means of transmitting on emergency frequency.

LOOSE ITEMS **SECURE**

Secure all loose items to prevent injury during touchdown and subsequent, possibly very rapid, deceleration. Any loose item can become a dangerous projectile or an object to be struck by aircraft occupants during the rapid deceleration following the touchdown.

SEATBELTS / HARNESSES SECURE

Ensure that all occupants have secured the seatbelts and shoulder harnesses properly positioned and tightened around their bodies. Proper shoulder harness position is critical in order to prevent deceleration related injuries.

- ▶ *If coats / jackets are available, fold them and utilize them as cushions between aircraft occupant heads and potential objects to be struck (e.g. control yoke).*

LANDING GEAR (as required) DOWN or UP

Determine the condition of the surface. If engine power is available, it may be advisable to overfly and scout the area prior to committing to a landing. If the surface is hard, smooth, and of sufficient length, consider landing with the gear down, if available. If the surface is rough and/or short consider landing with the gear up. Landing gear will not deploy using the landing gear lever if the electrical system has already been disconnected (such as during a previous emergency). If necessary, use the emergency gear release to deploy the landing gear.

FLAPS (as required) DOWN or UP

Consider the minimum amount of flap necessary for a safe approach and landing. In all cases, the priority is landing and stopping the airplane in the available landing area, with the main concern being the safety of the occupants, not the airplane condition after the landing. In the case of a gear-up landing, if runway length and condition permits, consider leaving flaps UP to minimize damage after touchdown.

MASTER SWITCH (on final approach) OFF

Once established on final approach, turn both sides of the Master switch OFF to eliminate the battery and the alternator as potential fire ignition sources after touchdown.

- **WHEN LANDING IS ASSURED, PRIOR TO TOUCHDOWN** -
Perform the following steps when landing is assured and on short final.

CABIN DOOR UNLATCHED

Unlatch the cabin door before touchdown, to prevent the door from getting jammed during the landing, and to facilitate evacuation after aircraft comes to a stop.

▶ **AIRCRAFT EVACUATE**

Even if there appears to be no fire after the aircraft comes to a stop, expedite evacuating the aircraft and obtaining external assistance. There is a chance that fuel will start leaking from ruptured fuel tanks and a definite fire risk exists.

DITCHING

WARNING

“The use of **power** in ditching is so important that when it is certain that the coast cannot be reached, the pilot should, if possible, **ditch before fuel is exhausted.**”

“Remember one axiom– *AVOID THE FACE OF A SWELL.*”

From AIM 6-3-3: Ditching Procedures

The Aeronautical Information Manual highlights the following as important for any flight crew planning to ditch the aircraft:

- It is vital to determine the condition of the water, and remember that the direction of the swells may not follow the direction of the wind. Landing into the wind without consideration of swell direction or directions (with multiple swell systems) greatly increases the risk of aircraft damage and loss of the occupants.
- Flight crews should avoid landing on the “face” of a swell, which is the side facing the observer regardless of swell direction. Doing so may result in the aircraft being rapidly swamped or thrown into the air, only to drop into the next swell.

If engine power remains available, fly over the intended landing area at a low enough but safe altitude to survey the sea surface and wind conditions.

- If landing parallel to the swells, there is little difference whether the aircraft lands on top of the crest or in the trough. Attempt to land at the top or on the backside of the swell, and select the heading that allows the greatest into-the-wind component.
- If landing in a confused sea (multiple swell systems moving in various directions) select the direction of the primary swell as the determining factor, and attempt to land on the backside of the secondary swell, if possible.
- If power is not available, conduct the approach so as to arrive over the water with enough airspeed to break the glide earlier and more gradually before the aircraft touches down.
- Once the pilot sees a stretch of water that appears favorable, cut power or, if power is not available, pitch up slightly to induce the stall and touch down at the best recommended speed as fully stalled as possible.

NOTE

These ditching procedures are based on the best available information and have not been demonstrated in an actual aircraft. Refer to AIM and other official publications.

DITCHING

▶ **ATC EMERGENCY NOTIFICATION** **COMPLETE**
SWELL FACE **AVOID**

- DETERMINE APPROACH DIRECTION -

LIGHT WINDS..... **PARALLEL TO SWELLS**
HIGH WINDS..... **INTO THE WIND**

LANDING GEAR **UP**
FLAPS **DOWN**
POWER (if available)..... **MINIMUM RATE OF DESCENT**
AIRSPEED **SLIGHTLY HIGHER THAN NORMAL**
CABIN DOOR..... **UNLATCHED**
TOUCHDOWN (Landing attitude) **MINIMUM AIRSPEED AND DESCENT RATE**

DITCHING, EXPANDED

▶ **ATC EMERGENCY NOTIFICATION** **COMPLETE**
Via all available means, notify ATC of the emergency:

- ✓ Use the **radio** to broadcast: “Mayday-Mayday-Mayday, Tail #, Ditching, Location (include body of water and land reference), # of Souls Aboard” on current frequency (Approach, Tower, etc.) or on 121.5, as appropriate. Continue transmitting and listening for a response as long as time permits.
- ✓ Set **transponder** to 7700 and **IDENT**.
- ✓ Engage the remote **ELT** switch on the instrument panel (if installed).

SWELL FACE **AVOID**
Remember to avoid the face of a swell!!

- DETERMINE APPROACH DIRECTION -

LIGHT WINDS..... **PARALLEL TO SWELLS**
HIGH WINDS..... **INTO THE WIND**

Select approach in accordance with sea direction and swell height and type, as recommended by AIM. Accept a higher crosswind component and avoid flying approach into a swell system if possible. Consult AIM for specific recommendations, and refer to POH / AFM for additional information.

LANDING GEAR **UP**
Check that the landing gear is UP to allow for a smoother touchdown, and to decrease the chance of the aircraft nosing over from the gear digging into water surface.

FLAPS..... **DOWN**
Extend wing flaps in increments and use full flaps, if possible, to achieve minimum speed on touchdown.

POWER (if available)..... MINIMUM RATE OF DESCENT

If power is available, use it to maintain minimum descent rate all the way through touchdown.

AIRSPEED SLIGHTLY HIGHER THAN NORMAL

Maintain slightly higher than normal approach speed, especially if engine power is not available, to allow for more positive control and gradual transition and dissipation of airspeed during roundout and touchdown.

CABIN DOOR..... UNLATCHED

Unlatch and open the cabin door before landing to prevent it from being jammed closed as a result of water impact.

TOUCHDOWN.....(Landing attitude) MINIMUM AIRSPEED AND DESCENT RATE

Set pitch and bank attitude during touchdown to sea, NOT to horizon. Touchdown in landing pitch attitude at minimum airspeed and descent rate.

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PROPELLER EMERGENCIES

PROPELLER OVERSPEED

THROTTLE..... RETARD
 OIL PRESSURE CHECK
 PROPELLER CONTROL.....FULL DECREASE RPM
 AIRSPEEDREDUCE
 PROPELLER CONTROL..... (as required) SET
 THROTTLE..... MAINTAIN BELOW 2700 RPM

PROPELLER OVERSPEED, EXPANDED

THROTTLE **RETARD**
 Retard the throttle to decrease MP, thus also decreasing RPM to avoid overstressing engine/propeller.

OIL PRESSURE **CHECK**
 Check oil pressure to see if low oil pressure is responsible for the propeller overspeed condition, by allowing the propeller blades to rotate to full low pitch, maximum RPM position.

WARNING

Low oil pressure below safe limits may indicate problems with the oil system in general. Consequently, other engine emergencies may follow shortly, and the PIC should take immediate and appropriate action while engine power is still available.

PROPELLER CONTROL..... **FULL DECREASE RPM**
 Retard the propeller control full aft, FULL DECREASE position to minimize propeller RPM.

AIRSPEED **REDUCE**
 Reduce airspeed to reduce airflow over the propeller and in effect reduce RPM due to windmilling.

PROPELLER CONTROL..... **(as required) SET**
 With throttle retarded and RPM in safe range, set propeller control, if any is available, to maintain desired RPM and avoid overspeed.

THROTTLE **MAINTAIN BELOW 2700 RPM**
 Use the throttle judiciously in conjunction with the propeller control, as described in the previous step, to maintain engine/propeller RPM combination below 2700.

► **LAND** **AS SOON AS POSSIBLE**
Although the aircraft remains flyable for the time being, locate a suitable airport or a landing site (as appropriate) and land as soon as practicable.

PROPELLER BLADE FAILURE

NOTE

These procedures are based on the best available information and are provided for training / informational purposes only, to assist the PIC in deciding on the best course of action in accordance with POH / AFM procedures. They have not been demonstrated in actual aircraft.

Consult POH / AFM and AOPA Safety Advisor, "Propeller Safety", for more information.

As of this writing, you can reach the "Propeller Safety" Safety Advisor at :

<http://www.aopa.org/asf/publications/sa06.pdf>

You may also use an Internet Search Engine to search for "AOPA Propeller Safety".

Propeller blade failure can cause the blade to physically separate from aircraft in flight, which will cause the propeller and engine to be severely unbalanced. This imbalance will cause severe engine vibration, which, if uncorrected, may be enough to shortly tear the engine off of its mounts. That, in turn, will render aircraft uncontrollable, due to CG shifting far back out of limits, because of the loss of engine weight in the front.

If propeller blade failure occurs and extreme vibration results, immediate action must be taken before control is lost.

PROPELLER BLADE FAILURE (SEVERE ENGINE VIBRATION)

THROTTLE IDLE
 PROPELLER FULL DECREASE
 MIXTURE IDLE CUTOFF
 PITCH ATTITUDE INCREASE TO STOP ENGINE ROTATION
 ► **LAND** **AS SOON AS POSSIBLE**

PROPELLER BLADE FAILURE (SEVERE ENGINE VIBRATION), EXPANDED

THROTTLE **IDLE**
 Retard the throttle to FULL AFT, IDLE setting to minimize engine power and vibration.

PROPELLER **FULL DECREASE RPM**
 Retard the propeller control full aft, FULL DECREASE position to minimize propeller RPM.

MIXTURE **IDLE CUT-OFF**
 Move the mixture full aft to IDLE CUT-OFF position, to cut fuel to the engine and shut it down.

PITCH ATTITUDE **INCREASE TO STOP ENGINE ROTATION**
 Pitch up slowly, to reduce speed and decrease airflow over the propeller, until engine and propeller stop their rotation.

- ▶ **LAND** **AS SOON AS POSSIBLE**
With airplane under control, execute appropriate Forced Landing or Ditching checklist flow, and perform an emergency landing at an appropriate landing site.

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