

# Amphibious Aircraft Gear Management Best Practices

## Minimum Guidance

This is a minimum set of generic guidance to help deter landing with the gear in the wrong position in amphibious aircraft. This guidance is designed to be included into most any AFMS and training materials for amphibious aircraft. AFMS and training materials for your specific aircraft should always be consulted for specific procedures relevant to your aircraft.

### On Takeoff

- Positive rate of climb on takeoff, gear up.
- Always climb to a minimum of 500 ft AGL or higher pre-chosen, consistent altitude, relevant to the performance of your aircraft, when switching landing surfaces to complete post-takeoff checklists.

### Post Takeoff

- Use a checklist appropriate to your aircraft for post-takeoff items or transitioning to cruise flight. Ensure it calls for a post-takeoff or cruise check to be sure that all landing gear are retracted.

### On Water-Based Landing

- Use landing checklist specific to your aircraft and water landing surface to ensure gear up, followed by three gear-position validation checks:
  - Upon completing flyover of your intended landing area to check conditions and wind, run your checklist. Check gear up for water landing.
  - 1st gear check on downwind or in coordination with a consistent pre-landing operation, also known as 1st trigger (e.g. – 1st power reduction, flap setting etc.): Check gear up for water landing.
  - 2nd gear check turning base or in coordination with a 2nd consistent pre-landing operation, also known as 2nd trigger (e.g. – selected flap setting, prop RPM adjustment etc.): Check gear up for water landing.
  - 3rd gear check when rolling out to final or established on final or other 3rd trigger: Check gear up for water landing.
- Use a standard pattern properly oriented about your intended landing location whenever possible.
- Visually compare intended landing surface to actual position of landing gear on each validation of gear position.
- Verbalize each gear position validation while visually reviewing each point, even in a single-crew environment.
- Pay attention to gear advisory system if installed.

### On Land-Based Landing

- Use landing checklist specific to your aircraft and runway surface to select gear down, followed by three gear-position validation checks:
  - Just prior to or upon entering downwind run your checklist: Gear down for runway landing.
  - Base or 1<sup>st</sup> trigger: Check gear down for runway landing.

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- Final or 2<sup>nd</sup> trigger: Check gear down for runway landing.
- Short final or 3<sup>rd</sup> trigger: Check gear down for runway landing.
- Visually compare intended landing surface to actual position of landing gear on each validation.
- Verbalize each gear-position validation while visually reviewing each point, even in a single-crew environment.
- Pay attention to gear advisory system, if installed.

## Other General Best Practices

- Do appropriate initial and recurrent training! It should be specific to your aircraft and configuration (straight float/amphib).
- Mnemonics (e.g. – GUMP-C, CIGAR etc.) when properly developed and used in conjunction with the checklist for a particular aircraft can be helpful for checklist accuracy, speed and flow of checklists and minimizing pilot workload and completing reviews of configuration after the checklist has been utilized.
- Treat every aircraft you fly as an amphibian and do your gear/surface checks consistently.
- Minimize cockpit distractions and maintain a sterile environment during critical phases of flight. When practicing landings and takeoffs always do your gear checks for water landings consistently.
- Engage your brain, pay attention to what you are saying, seeing and hearing. Many pilots are heard verbally confirming the gear in the wrong position for the surface and not paying attention to what they are actually doing.

This summary is designed to be as generic as possible and is a tool to promote a unified view from seaplane industry representatives. How we implement this generic write up in our checklists, manuals, training and marketing will vary amongst us, but the concepts should not change.

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## Expanded Explanation

The past few years have been concerning for seaplane flying in terms of incidents and accidents due to landing with the gear in the wrong position for the intended landing surface. While factual data is not officially collected and reported by the NTSB to validate exact numbers of accidents relative to other years, there is widespread acceptance that 2020 saw an increase in this type of incident and accidents. In response, the Seaplane Pilots Association collaborated with a variety of amphibious aircraft and equipment manufacturers to develop best practices in gear management for amphibious aircraft. The resulting guidance focuses on generic principles that can be applied to any amphibious aircraft and its associated checklist and procedures. While there is no way to completely remove the risk of landing with the gear in the wrong position for an intended surface, adhering to the following guidance will help minimize the risk.

## On Takeoff & Post Takeoff

In the takeoff regime, focus should be on the following three practices that will minimize the future chances of making a water-based landing with the gear in the down, or extended, position. The reciprocal event—making a land-based landing with the gear up—typically causes a minor amount of damage that is easily repaired and is not generally life threatening. The bottom line: The gear should only ever be in the down position when landing on a hard surface is intended.

The first practice is raising the landing gear, or including a check that gear is up after a water takeoff, as soon as a positive rate of climb is established. This procedure is similar to what is taught in multiengine aircraft. This practice can be different from single-engine retractable-gear aircraft operations where the gear is left extended until no usable runway remains. The rationale behind positive rate, gear up is that many gear-down-in-water accidents stem from the gear never being raised after a takeoff from land. In many amphibious aircraft an extended landing gear does not create a significant degradation in performance. This makes it difficult to notice, and therefore easy to overlook, that the gear is down because the airplane isn't performing like it normally does. The risk of landing in the water with the gear down far outweighs the risk of an engine failure when usable runway remains after the landing gear has been retracted. Even if the engine does fail, landing on the hull(s) on or off runway is typically benign, and less damage occurs than a gear-down-in-water incident. As the pilot transitions to the cruise portion of flight, a checklist should be used that checks to ensure the gear was raised.

The second practice is most relevant when operating from airports that are adjacent to a body of water that is the intended landing surface. When switching landing surfaces, going from a land-based runway to a water landing site, or vice-versa, always climb to a minimum altitude to establish a transition process. It is recommended that this threshold not be less than 500 ft AGL; the final altitude should be suitable and relevant to the performance of the aircraft you are flying. The higher performance and more capable the amphibian the higher the altitude you may want to consider. Pattern altitude is also a convenient norm as it coincides with typical flying practices and procedures and would be sufficient for the performance of the vast majority of amphibians. Climbing to this minimum altitude every time you switch landing surfaces sets the stage for a mental transition and provides time to follow a standard process that minimizes landing on any surface with the gear in the wrong position. In reviewing accidents in which the gear was left down for a landing on water, it is not uncommon to find that the pilot departed a land-based airport and immediately transitioned to a landing in an adjacent lake without ever raising the gear. This can happen because the pilot never reached the phase of flight where

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the aircraft is cleaned up and post-takeoff checks or climb checks completed. Nor did the pilot go through the standard landing-process checks in this scenario because the takeoff phase of flight was never completed, let alone a complete and thorough landing pattern and process.

The third and final recommendation is that after takeoff and reaching the pre-determined altitude as recommended above, it is important to complete a check to make sure the gear was not left in the down position. Use this altitude to trigger an appropriate post-takeoff or cruise-flight checklist for your aircraft that calls for a gear-position check. This is important even if you don't fully intend to transition to cruise and may land at a nearby waterway before reaching cruise speed or altitude. Reaching this altitude and performing the recommended checks will provide an opportunity to mentally transition from one surface to another while providing another opportunity to ensure your gear is in the proper position.

## On Landing

The core best practices revolve around (1) using a checklist specific to the surface you intend to land on to aid in the decision and selection of gear position; (2) using a consistent and proper process to validate gear selection and position; (3) using this process a minimum of three additional times during the approach and landing phase to validate gear selection and position and; (4) paying attention to your gear advisory system if installed. These best practices will be expanded upon in this order.

Many pilots don't see fault in using a combined runway/waterway checklist that simply calls for the pilot to make a decision on where the gear should be depending on which surface is being utilized. When all things are normal and correct there is not a significant problem in using this style of checklist. When a problem does exist this style of checklist does not call out an error effectively. If a pilot is landing on the water and uses a checklist specific to water operations, it becomes apparent when the gear is not raised as the checklist calls for raised gear. Using a combined checklist, the gear in the wrong position does not stand out necessarily as both gear positions are listed on the same line of the checklist to be differentiated only by the pilot's judgment. Even an abbreviated checklist that differentiates between landing surfaces is helpful in recognizing an error in gear position relative to intended landing surface.

The process of using several gear-check triggers is critical. Each time a gear-position validation check is completed a process should be used to crosscheck the intended landing surface with the gear-position selected and the reality of the actual gear position. This is most comprehensively done by a combination of a visual and verbal confirmation. In each check the pilot looks at the intended landing location, then verbalizes what the intended landing surface is, either a runway or water surface. Then the pilot visually checks the position of the landing gear selector and verbalizes the gear-selector position. Finally, visually check and verbally state whether or not the gear indicator lights and physical position of each gear matches the gear selector position. It is not sufficient to just do the following check:

*"Landing on a runway, the gear should be down."*

Or

*"Gear is selected up, gear lights indicate up."*

In the first example, did the pilot actually select gear down? Did the gear do what it was supposed to do? In this example the pilot has validated intent, but not proper selection of the gear position nor actual position of the gear. In the second example, is the pilot intending to land on water? It wasn't

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stated as such. It is very important to crosscheck the surface *intended* for landing with the gear position *selected* and where the gear *actually* is positioned.

*“I need the gear down for landing on Runway 16 at KSGS, the gear is selected down for runway landing, and the gear is confirmed down.”*

Or

*“We’re landing on water at Rainy Lake, the gear is selected up, and the gear position matches the gear selection.”*

While the visual aspect of a gear check is obvious in helping us assess what actually is, the verbal aspect is equally important. While it may be awkward at first, verbalizing the checks helps engage the pilot while performing the gear position checks. Also, many experienced instructors have been in the situation where a wrong choice was made, or the gear didn’t raise or lower like it was supposed to, and the pilot read through the process perfectly with the gear in the wrong position. Verbalization also engages others in the cockpit or cabin to help catch an error before an incident or accident occurs.

Human factors experts will note that anytime a person has to make a decision, no matter how simple, there is a certain rate at which the wrong choice will be made. This error rate is the rationale for calling for a gear-position check three more times in addition to running the initial landing checklist. Repeating this process three times before landing allows for an error to be realized, caught, and corrected prior to an accident or incident happening. This is particularly true for seasoned pilots who have had “gear down for landing” ingrained in their habit from many years of flying non-amphibious aircraft.

To seamlessly incorporate these gear-position checks, two strategies can be employed. The first is conducive to land-based landings at typical general aviation airports where standard patterns—at minimum a downwind, base and final—are used. Whenever possible, it is recommended that a typical pattern also be utilized in water-based landings to promote consistency and predictability. Recognizing that this isn’t always possible, a second strategy can be employed.

The first strategy begins with the normal execution of your Before Landing checklist as you enter the pattern on downwind or before. After this initial checklist run, three more gear-position validation checks should occur, one each on base, final and short final. Whether you start this process earlier in the pattern or on downwind is more a matter of personal preference or company procedural process. Three gear checks after completing the Before Landing checklist is key, and the gear checks should be completed as previously discussed.

When a typical pattern can’t be flown a different strategy needs to be employed to drive the three gear checks prior to touchdown. Since the pilot doesn’t necessarily have the downwind, base and final marks to drive the three checks, it is recommended that they be tied to discreet actions that configure the aircraft for landing, also known as triggers. These triggers should become a natural lead-in to doing a gear check during the landing process. The process starts with an overflight of the intended landing site and using a pre-landing checklist designed for water-based landings to validate proper gear position for a water-based landing. The remaining three gear-position validations should be tied to discrete actions—triggers—between the initial flyover and touchdown that configure and prepare the aircraft for landing. These discrete actions will be different from aircraft make and model to aircraft make and model, but once decided upon should remain consistent. Some examples of events that can be used are

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changing the position of the flaps, power reductions, carburetor heat engagement, propeller pitch adjustments, etc. The key is finding a minimum of three discrete operations that occur for every landing no matter the surface or circumstances. Tying gear-position validation checks to these discrete operations ensures that the minimum number of checks is completed prior to touchdown.

Finally, if the aircraft has a gear advisory system installed, the pilot should think through what the expected behavior will be from the advisory system when approaching touchdown. This system is often the last line of defense against a landing with the gear in the wrong position. If this system prevents an accident or incident, it means there were many failures on the part of the pilot to recognize the gear-position problem. Pay attention to the gear advisory system. If what you expect to be heard or seen does not match what is heard and seen, perform a go-around to assess what is wrong, so long as no emergency situation exists to prevent a safe go-around.

## Other General Best Practices

A key difference distinguishes flying an amphibious seaplane from flying any other category and class of aircraft. That difference is that you land with the gear up when water is the intended landing surface. With this key difference comes nuances in how we think and operate the aircraft. For this reason, professionally developed and delivered initial and recurrent training specific to the aircraft is always valuable. This training helps to develop and retain the habits that prevent landing with the gear in the improper position.

Many amphibian-seaplane pilots fly several different makes and models of aircraft. If this is true, then treat every aircraft flown like an amphibian. Performing consistent and similar gear checks no matter the type of aircraft, landplane or seaplane, maintains consistency in process and should result in always landing with the gear in the correct position.

Minimize cockpit distractions and maintain sterile environment during critical phases of flight, particularly takeoff and landing. This is true when flying any aircraft, but particularly important in amphibians where gear position is critical depending on the landing surface.

When practicing takeoffs and landings at an airport, avoid flying circuits without raising the gear. Raise and lower the gear on each circuit and do your three-four gear checks in coordination with the leg of the pattern, or triggers that work for the aircraft make and model. Likewise, when practicing water landings and takeoffs, do your gear checks consistently with pattern legs and/or triggers, even though the gear position may have never moved since the first landing. These practices ensure that good habits are built and maintained.

Engage your brain. Complacency is the first step to landing with the gear in the wrong position. If careful attention is not given to what is being said and what is going on, it is easy to make a mistake and miss critical indications that something is very wrong until it is too late. As general guidance, an amphibious aircraft should be considered more vulnerable to a catastrophic accident, which may include serious injury and death, with the gear down. While all efforts should be taken to avoid landing on either a runway or a waterway with the gear in the wrong position, landing on a runway with the gear up tends to be much more benign, with minimal damage and injuries, compared with landing on water with the gear down. Avoiding either scenario is best done by being attentive and not complacent.