CIVIL AVIATION AUTHORITY
OF NEW ZEALAND
Te Mana Rererangi Tūmatanui o Aotearoa

Advisory Circular
AC121-7 & AC125-2

Revision 2

5 April 2025

Ditching – Techniques, Hazards, and Survival

General

Civil Aviation Authority (CAA) Advisory Circulars (ACs) contain information about standards, practices, and procedures that the Director has found to be an **acceptable means of compliance** with the associated rule.

Consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices, or procedures are found to be acceptable they will be added to the appropriate AC.

Purpose

This AC describes an acceptable means of compliance with the requirements under Civil Aviation Rule Parts 121 and 125 relating to ditching of an aircraft. It discusses ditching techniques, preparedness and procedures that may enhance the chance of survival should a ditching becomes necessary.

Related Rules

This AC relates to Parts 121 and 125, specifically to rules 121.67, 121.363, 125.87 and 125.363. It also relates to rule 91.525.

Change Notice

Revision 2 makes minor stylistic updates and removes broken links in the *Further Reading* section.

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Version History

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Revision No.	Effective Date	Summary of Changes
AC125-2, Rev 0	20 July 2010	Initial issue
AC121-7 & 125-2, Rev 1	26 October 2023	Changed the title to incorporate Part 121, *Air Operations Large Aeroplanes* Substantially updated the content and format throughout and changes the order of some sections Deleted the Risk Assessment and Mitigations section as guidance is now available from other ACs Added to the Definitions section Added an Abbreviations section and a Version History Added an appendix of suggested checklists
AC121-7 & 125-2, Rev 2	5 April 2025	Makes minor stylistic updates and removes broken links in the Further Reading section.

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Introduction

A ditching is defined by ICAO as a forced landing of an aircraft on water or a planned event in which flight crew knowingly make an emergency landing on water (excluding float plane landings in normal water landing). As a term, it is commonly used only for aircraft that are not designed for water operations. However, ditching is of interest to all operators who fly over water, regardless of the size of the aircraft, the size of the body of water, or the closeness to shore.

This AC is intended to provide operators conducting extended overwater operations under Parts 121 and 125 with enough information to enable them to comply with the intent of rules 125.87(a)(2) and (3), and 125.363 (3). Rules 91.525 and 121.363 also contain provisions for flights over water. These rules deal with ditching from a risk management perspective, so that in the rare event that a ditching is required operators will be well enough prepared to maximise the chances of survival.

This AC provides general guidance for medium fixed-wing aircraft which may also be applicable to other types of flight operations. Unlike large aircraft, ditching certification is not required for medium-fixed wing aircraft. Part 125 operators do, however, need to be prepared enough to maximise the chances of survival if ditching is necessary. This would be accomplished through a comprehensive plan which includes emergency procedure training, equipment, and briefings to passengers, with the explanation of how this would be carried out outlined in a Part 125 certificate holder's exposition.

Aircraft flight manuals (AFMs) may or may not include information about ditching. Ditching capability is often not required for certification, and the guidance provided in an AFM is often based on past occurrences and outcomes. This AC provides information gained from experience and considers likely scenarios of possible future events in the smaller aircraft context.

We encourage operators to refer to this AC when preparing their respective expositions and safety manuals. For more information, refer to the *Further Reading* section at the end of this AC.

Note: *While this AC does not cover Part 135 operations, there may be useful general guidance that is applicable to briefing and preparations for those types of aircraft. Operators should be aware, though, that as the technical specifications for helicopters and small aircraft are different to larger aircraft, much of the technical advice will not apply.*

1. Definitions

Altimeter	An instrument used to measure the altitude of an object above a fixed level. The measurement of altitude is called altimetry, which is related to the term bathymetry, the measurement of depth under water
Aneroid altimeter	An altimeter calibrated to show the pressure directly as an altitude above mean sea level, in accordance with a mathematical model atmosphere defined by the International Standard Atmosphere (ISA).

Ditching	The forced landing of an aircraft on water[1], or a planned event in which flight crew knowingly make an emergency landing on water[2].
Mammalian diving reflex	A protective mechanism for humans in cold water immersions which increases the body's chance of survival. This reflex is most evident in marine mammals such as whales, seals or porpoises.
Radio/radar altimeter	An altimeter that measures altitude more directly, using the time taken for a radio signal to reflect from the surface back to the aircraft. Alternatively, Frequency Modulated Continuous-wave radar can be used. The greater the frequency shift, the further the distance travelled.
Sea state	The general condition of the open sea, e.g. wave height and swell.

2. Abbreviations

While some abbreviations used in this AC are standard abbreviations from Part 1, *Definitions and Abbreviations*, they have been listed here for convenience.

AC	Advisory Circular
AFM	Aircraft Flight Manual
ATS	Air Traffic Services
CAA	Civil Aviation Authority
CASA	Civil Aviation Safety Authority (Australia)
EDTO	Extended Diversion Time Operations
ELT	Emergency Locator Transmitter
FAA	Federal Aviation Administration (USA)
FCOM	Flight Crew Operating Manual
HF	High Frequency
HSWA	Health and Safety at Work Act
ICAO	International Civil Aviation Organization
ISA	International Standard Atmosphere
MEL	Minimum Equipment List
QRH	Quick reference handbook
SFA	Senior Flight Attendant

3. Crew Training

The actions of passengers in an emergency have a significant impact on survival. Accident investigations have highlighted the importance of crew being adequately briefed and prepared, so they can guide passengers appropriately.

[1] Reflecting the definition in ICAO Annex 12 – Search and Rescue, Ch 1 Definitions p 1-1.

[2] ICAO Manual on the Investigation of Cabin Safety Aspects in Accidents and Incidents, 5.11.1

Ditching is likely to be very stressful and frightening for passengers, who may act erratically. Therefore, professionals need to be trained and ready to deal with this situation, to guide passengers and deal with any panic.

Training requirements are covered under rules 121.533 and 125.553. These requirements specify that training programmes must be carried out in a structured manner, without unacceptable risk to equipment, personnel, or third parties. They consist of:

- introduction training
- transition training
- upgrade training for flight crew members, and
- recurrent training.

Training can be carried out by the operator, or by an aviation training organisation, in real situations or via simulation programmes. It needs to be recurrent and strongly embedded in crew members so they can carry out the correct procedures almost automatically and persuade passengers to follow their lead.

In most cases training will be limited to scenario-based discussion and practical drills. These are best conducted in a controlled environment and some operators have employed quite sophisticated wet simulators for this purpose. In accordance with rule 119.55 (b)(1), operators need to ensure that the facilities are appropriate for the tasks to be performed, in this case useful training exercises.

However, smaller organisations can make use of and obtain worthwhile training benefits from using a nearby swimming pool complex for a wet drill. The best results are obtained from exercising in water more than two metres deep, so participants can extend to their full body length without touching the bottom.

Crew member training should include the practice of launching rafts, righting an overturned raft, inflating life jackets, donning life jackets, entry into the raft from the water, when in the water and fully clothed, assisting others into rafts and putting up the raft canopy, and practising anti-hypothermia techniques etc.

Training needs to be conducted using lifesaving equipment that is identical to that installed in the aircraft, e.g. whether a life raft or a slide raft.

Some operators may be approved to run full wet drills in a facility that meets requirements, with regards to the size and depth of the pool. This gives crews the chance to practise how to:

- Access the raft compartment, experiencing the difficulty associated with moving the weight of a packaged raft.
- Examine all features of a fully inflated raft
- Board raft(s), assist persons into the raft
- Access the inflation lanyard
- Access the raft release mechanism
- Review the raft survival kit

- Launch the raft
- Right an overturned raft
- Show their understanding of good raft management and maintenance
- Erect the raft canopy
- Demonstrate a good distribution of duties to passengers, and
- Identify hazards.

Operators conduct raft drills on land or in water, however best practice would be for drills:

- to be conducted in a swimming pool deep enough that no candidates may touch the bottom
- to alternate between night and day scenarios, and
- to take place every 36 months.

Cabin crew also need to show competency in the location and operation of emergency equipment every 12 months.

Practical training should be complemented by theoretical training in the same subjects. Crew also need to prepare for how best to brief passengers, as part of routine and emergency briefings, as outlined in more detail below.

Note 1: *Some rafts may not be suitable for use in the aircraft again after being exposed to chlorinated or salt water. Operators should use a raft that is dedicated to training and will not be required for in-service use.*

Note 2: *The appendix provides some checklists and lists of things to consider when doing wet drills.*

Rule 121.555 provides for the syllabus for training crew members of large aircraft. In particular, rules 121.555(b) (4) & (5) stipulate that training for all types of emergency and abnormal situations or procedures, including the location and operation of emergency equipment, must be provided as part of the training syllabus.

4. The hazards of ditching

Ditching is extremely hazardous, and should only be considered when no other reasonable option is available. In rough seas, the aircraft may break up and sink rapidly, leaving little time for escape. If the water is cold and access to a life raft is not available, survival time is limited.

People on board the aircraft have a high chance of surviving the aircraft's initial contact with the water. Statistics show that 88% of controlled ditching events result in only a few injuries to pilots or passengers.

Fatalities are more likely to happen from drowning after ditching if escape from the aircraft is delayed. There are many reasons for this, such as not understanding or being unfamiliar with escape requirements, disorientation, shock, or simply being unable to release seat belts or open emergency exits.

During the ditching manoeuvre, the ability of the airframe to remain intact depends to a large extent on the surface conditions at the time, and the technique used to ditch the aircraft. Two 2009 ditchings are provided for comparison. The ditching of an IAI Westwind near Norfolk Island resulted in the main door being unusable and the fuselage quickly filled with water. The passengers and crew only just managed to get clear of the aeroplane before it sank.

In contrast, the ditching of an A320 in the Hudson River, New York, showed that a controlled ditching onto a body of relatively calm water may result in little damage to the airframe and it may remain intact, and float in a reasonably level attitude for a significant amount of time.

5. Decisions and preparation

Why consider ditching?

Some reasons for considering the ditching option are:

(a) **Fire:** An uncontrollable fire may provide few options other than to put the aircraft down as soon as possible.

(b) **Fuel exhaustion or contamination:** Should the aircraft be facing total fuel exhaustion or fuel contamination it is best to use what fuel is left to make a controlled landing.

(c) **Aircraft performance or systems degradation:** This can be due to total or partial loss of power (e.g. fuel exhaustion or contamination, volcanic ash encounter), or airframe, electrical or control issues that make continued controlled flight impossible.

If ditching is being considered, pilots should decide quickly so there is enough time remaining for an emergency briefing and any cabin preparation that is necessary. This increases the possibility that the ditching can be done as a controlled event under power.

Preparation

Plan

Having a plan is particularly important when faced with a ditching. A ditching is a manoeuvre that is flown according to a plan (**a water landing made under control**) as opposed to a crash into water (an uncontrolled water landing)**.**

It is ideal that a plan is flexible. The plan may need to be reviewed as the flight unfolds, but it is essential to **have a plan and act upon it**. Ditching is a high-risk manoeuvre but following a well-developed plan will increase the chance of survival.

Planning for the actual water touchdown may be limited by the time available. Some aspects to consider ahead of time, and if possible, actioned in the event of the emergency, are provided below. Checklists may also help. A sample checklist that can be tailored to individual aircraft or operations is included in this AC as Appendix A.

Standard pre-flight briefing and checklists

Note*: The Appendix outlines suggested checklists in more detail.*

Crew members need to give a briefing before a flight, in accordance with rule 91.211. While this has to cover more than preparations in the event of ditching, it does need to outline what passengers and crew need to do if ditching is necessary, including obeying crew instructions and the instructions in signs, if applicable. Crew should also brief passengers on:

- the location of exits
- the location of all survival and emergency equipment for passenger use, and
- the vital fact that lifejackets can be donned and infant life jackets given out and donned (but not inflated until out of the aircraft).

Crew should also ensure there is a checklist of what to do in the event of ditching. This should cover:

- How to include the communication needs of special category passengers, e.g. people with limited hearing
- What to do for other special category passengers, such as those with limited mobility
- What to tell Able-Bodied Passengers (ABPs), especially those sitting in exit rows
- Instructions to give to ABPs on:
    - how to help remove lift rafts from storage
    - how to help launch life rafts
    - how to help with putting on life jackets
    - the location of water bottles that can be taken onboard the raft, and
    - what equipment to take in the case of an unplanned ditching.

Pre-ditching briefing

If it becomes apparent that a ditching is likely, and time allows, the Captain should brief the Senior Flight Attendant (SFA) at the earliest opportunity, providing any useful information, in case they are unable to communicate after the ditching.

As a minimum, this briefing must include:

- time remaining to ditching
- anticipated sea conditions
- confirmation that their MAYDAY call has been received
- instructions to prepare the cabin for ditching, and
- confirmation to act in accordance with the operator's ditching procedures, as necessary, to evacuate everyone safely after the ditching.

In turn, the SFA should read back this briefing to the Captain to ensure that it has been correctly understood. The SFA should, in turn, brief all other crew and when cabin preparation for ditching has been completed advise the Captain accordingly.

Cabin

(a) The amount of pre-ditching preparation that can be completed will depend on the amount of time available.

(b) Loose items both in the cabin and flight deck area should be secured. A good place to put all the loose items is in a toilet cubicle if the aircraft has one available.

(c) Securing loose items is important because they not only become missiles which may cause injuries at impact, but they may also float should water enter the aircraft. Floating debris inside the cabin may hinder evacuation.

(d) Depending on the situation (e.g. nature of emergency, preparation time available, ditching environment) it may be prudent to don extra clothes before ditching to reduce the effects of hypothermia following water entry. Passengers should follow the directions of crew, and in any case, should avoid donning large loose clothing items such as overcoats which may become snagged when exiting the aircraft.

(e) All persons on board should don their life jacket, but passengers need to be reminded by the crew **not** to inflate them until leaving the aircraft.

(f) Preparations need to be made for retrieving, launching, and securing life rafts, or for the launching of side rafts (depending on the type of aircraft).

Distress Call

(a) The Mayday call should be made on the current radio frequency if in radio contact with air traffic services (ATS). The emergency locator transmitter (ELT) should also be activated at this time.

(b) If operating in oceanic airspace, distress calls should be made on 121.5 MHz, the appropriate enroute frequency, HF or via data link (e.g. CPDLC, ADS-C).

(c) The transponder should be set to 7700.

(d) Other aircraft may assist in relaying emergency details to ATS if direct contact is difficult.

The water landing

Power

Having power available allows control over the rate of descent and allows a greater choice of the actual touchdown point. Therefore, the decision to ditch should be made while power is still available.

Aircraft weight

When impacting on the water under control, the best results would be achieved with a low stall speed, i.e. low weight. Therefore, if practicable, excess weight should be jettisoned (i.e. dumped) from the aircraft before impact.

With many aircraft the only action available to reduce weight may be to jettison excess fuel, but this should only be considered if a ditching is inevitable, and no other hazards are created as a result. For example, to jettison fuel is not recommended if your aircraft is about to run out of it, or if part of the aircraft is on fire, and it is important to bear in mind that a lighter aircraft will have reduced touchdown speed.

Aircraft configuration

If required to ditch, the procedures found in the AFM or Emergency Checklist should be followed unless another course of action is necessary in the interest of safety. These procedures will usually call for the ditching configuration to be: gear up, intermediate or

maximum flap and minimum approach speed. For fixed undercarriage aircraft a lesser flap setting could enable the aircraft to rotate to a high nose attitude just before touchdown. However, a degree of judgement is required here, as a high nose attitude limits forward vision which may have an adverse effect on the last and most important part of the approach.

Fixed gear aircraft may exhibit a violent nose-down pitching moment which may cause the nose section to go well underwater after impact. The actual behaviour after impact will be different for each aircraft type. Those with a significant portion of their structure in front of the main wheels may exhibit a less violent forward pitching moment. For retractable gear aircraft, the pilot and crew should be prepared for two impacts. The first is slight as the tail touches down, the second is severe as the aircraft violently decelerates and the nose dives below the surface.

Direction of ditching

Selection of the landing direction will to a large extent affect the outcome of the manoeuvre. Pilots should be aware of the following:

(a) **Rivers:** As there is limited choice available, a landing along the axis of the river is usually the only manoeuvre possible. If time permits, choose the best wind option.

(b) **Lakes and small bodies of water:** The size of the body of water, and its approaches, will be the main considerations here. If possible, land into wind, parallel and close to shore. Choose an area which will allow easy access to the shore after evacuating the aircraft. Landing adjacent to a cliff should be avoided! If circumstances allow, a low pass over the selected ditching area checking for objects just below the surface would be beneficial.

(c) Large bodies of water:

(i) ***Smooth water or long swells:*** Land into wind. Follow the manufacturer's recommendations, if any, or those discussed above if there are none.

(ii) ***Breaking waves or large swells*****:** Once again follow the manufacturer's recommended procedure, if any. If none is provided, then the best technique will be to land along the swell, accepting the crosswind and higher touchdown speed.

The best technique is to land on the top of the swell, or on the back of the swell. Try to avoid touchdown on the advancing face of the swell.

Try to land in the water with the airframe aligned with the direction of travel. This may require considerable correction for drift in strong crosswinds. Landing in this manner will reduce the side loads on the fuselage structure and maximise the chance of maintaining structural integrity after contact with the water has been made.

Table 1: Wind versus sea state

Wind Speed	Appearance of Sea	Effect on ditching and suggested landing direction
0-6 knots (kt)	Glassy calm to small ripples.	Height very difficult to judge above glassy surface. Ditch parallel to swell.
7-10 kt	Small waves; few (if any) white caps.	Ditch parallel to swell.
11-21 kt	Larger waves with many white caps.	Use headwind component, but still ditch along general line of swell.
22-33 kt	Medium to large waves, some foam crests, numerous white caps.	Ditch into wind on crest, or downslope of swell.
34 kt and above	Large waves, streaks of foam, wave crests forming spindrift.	Ditch into wind on crest or downslope of swell. Avoid, at all costs, ditching into face of rising swell.

Figures 1 and 2, overleaf, illustrate that aircraft with low touchdown speeds should touch down into the wind. Aircraft with high touchdown speeds should choose a compromise heading between wind and swell (with strong wind and swell – land on back of swell).

Figure 1: Possible touchdown directions adjusted for touchdown speeds (Source: FAA)

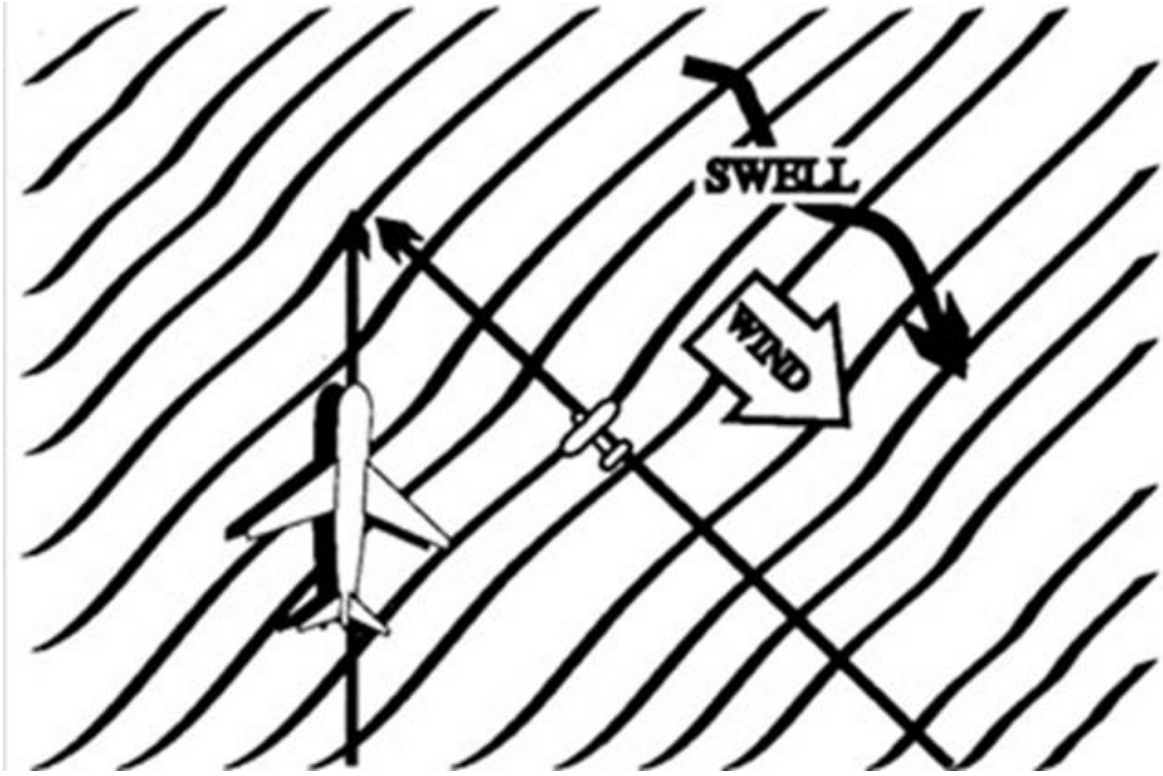
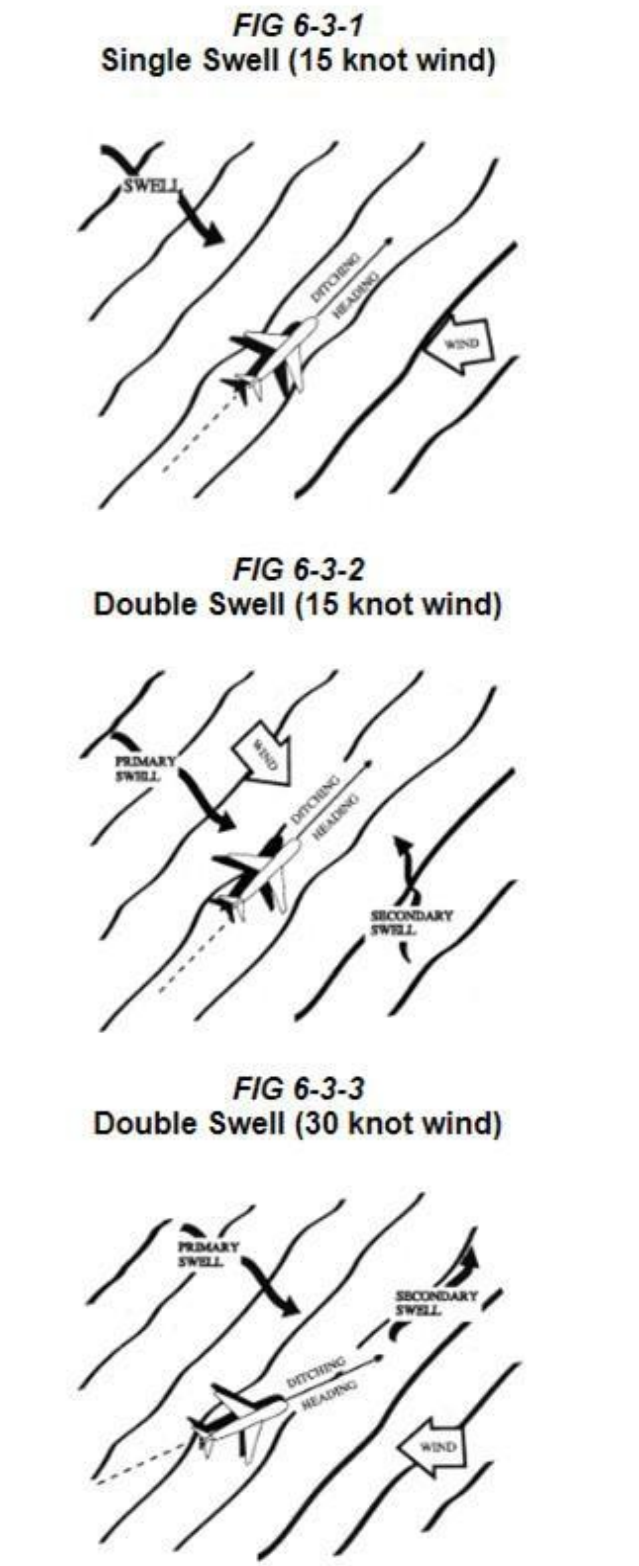


Figure 2: Possible touchdown directions in relation to swell and wind (source CASA)[3]



[3] CASA AC91-09, *Ditching*.

(d) Night Ditching:

(i) Unless there is 4 octas of cloud or less, and a full moon, judging surface conditions at night will be very difficult. Knowledge of the local weather forecast and in particular the swell state would be beneficial under these circumstances.

(ii) An aneroid altimeter will be of little use unless there is an accurate altimeter setting. A radio/radar altimeter is better, if available. Otherwise, pilots should set up a low rate of descent (less than 200 ft per minute) and wait. This is another good reason for conducting a powered approach if power is available. Flight deck instrumentation on modern aircraft can also provide an indication of wind which should be used when ditching, particularly at night.

(iii) The GPS may be used to derive wind and drift data if flight can be sustained at low level long enough for the data to be displayed prior to ditching. In some cases, however, such as Part 121 aircraft, wind indication is constant and almost instantaneous.

(iv) At night, optimal use of lighting could be critical. Cockpit lights should be set as low as possible to optimise night vision and pilots should consider using landing lights or possibly taxi lights. Landing lights should be used with caution due to their disorienting effect, particularly during periods of high wind, high sea and/or surface spray conditions. If the air is misty (highly likely if there is blowing spray), the glare of external lights could upset night vision.

(v) Nearing the surface reduce the rate of descent to 200 fpm or less, or select the minimum approach speed.

Surface contact

It is best to land on the water under full control and as slowly as possible. Pilots should use remaining power to advantage and reduce the rate of descent to the minimum so that gentle contact is made with the surface.

Unless the landing attitude is specified by the manufacturer the optimum attitude for most types is about 10 degrees pitch up. On Part 121 aircraft, pilots should follow the quick reference handbook (QRH) checklist procedure for final approach and touch down techniques when ditching.

Pilots should try to ensure the wings are kept level so that they contact the water at the same time. Should one wing tip contact the water first it can cause a large slewing motion which will result in loss of further control and a violent impact with the surface.

Evacuation

Rapid evacuation in an orderly and organised manner will increase the chances of survival. This is best achieved if all passengers and crew understand their responsibilities and what actions they must take. A comprehensive briefing, pre-flight and during the descent phase before impact, is highly recommended.

Some aircraft float nose high, so care should be taken before using the rear doors during the evacuation. The aircraft is more likely therefore to sink tail first, so even the use of over-wing exits may not be advisable as this area could be immersed before the front exits are opened.

Therefore, if the over-wing exits were opened, the fuselage would fill with water quite rapidly and thus considerably reduce the "floating time" of the airframe. This may be very short, even in the best of circumstances.

Life rafts are often quite heavy and bulky, so crew members should get help from others when launching the life rafts (on aircraft not equipped with automatic slide rafts).

6. After Ditching

Survival

Survival is a complex issue. However, there is some evidence to suggest that 50% of those that survive the ditching could be rescued. It is advisable to plan for the worst and think: "it could happen to me". This means looking at reasonably foreseeable outcomes and putting strategies in place to minimise their impact on survivability. Specialised training, appropriate to anticipated operational and climatic conditions, is also recommended.

Once the life rafts are in the water and inflated, they should be tethered together to avoid drifting apart. It may be difficult for some persons to get themselves out of the water into a raft, so it is recommended that fitter persons are the first in so they can help others out of the water.

Sustaining human life may not be possible in certain environments. Continued survival will depend on water and air temperature, wind and sea state, clothing, the availability of survival equipment and the physical condition of the survivors.

It is very important that rescue be as quick as possible. To aid in the rescue effort, the emergency locator transmitters should be activated, and that flares and other suitable devices, such as mirrors, if the ditching is being carried out in daylight, should be ready to use if a ship or aircraft is heard or sighted.

Hypothermia

One of the prime causes of death is hypothermia. If a person is immersed in cold water, survival time will depend to a large extent on the onset of hypothermia.

Cold water

For the purposes of this AC, cold water is defined as the temperature that triggers the mammalian diving reflex – approximately 21 degrees Celsius[4] and less. This is described in more detail later in this AC.

What happens in cold water?

The first hazards to contend with are panic and shock, which means the physiological changes – e.g. heart rate and breathing. That initial shock can place severe strain on the body, producing instant cardiac arrest.

[4] Definitions of "cold water" vary. A strict definition would be anything less than body temperature. However, Dr Alan Steinman, co-author of *Cold Water Immersion* notes that "significant risk of immersion hypothermia usually begins in water colder than 25°C"; while for the purposes of their regulations the United States Coast Guard define cold water as where the monthly mean temperature is less than 59°F (15°C).

Survivors of cold-water accidents typically comment that their breath is driven from their lungs on first impact with the water. If a person's face is in the water during that first involuntary gasp for breath, they are most likely to inhale water rather than air. Total disorientation may occur after cold water immersion. Persons have reported "thrashing helplessly in the water" for thirty seconds or more until they were able to get their bearings.

Immersion in cold water can quickly numb the extremities to the point of uselessness. Cold hands cannot fasten the straps of a lifejacket, grasp a thrown rescue line, or hold onto an over-turned raft. Within minutes, severe pain clouds rational thought. Finally, hypothermia sets in, and without rescue and proper first aid treatment, unconsciousness and death.

Normal body temperature is 37 degrees Celsius. Shivering and the sensation of cold can begin when the body temperature lowers to approximately 35.8 degrees. Loss of cognitive ability can begin to set in at approximately 34, unconsciousness at 30 and death at approximately 26 degrees.

What to do in the water

Cold water robs the body's heat 32 times faster than cold air. If a person should fall into the water, all efforts should be given to getting them out of the water by the fastest means possible.

All crew members should be thoroughly skilled in rescue and self-rescue techniques.

Physical exercise such as swimming causes the body to lose heat at a much faster rate than remaining still in the water. Blood is pumped to the extremities and quickly cooled. Few people can swim a mile (1.6 kms) in water which is only 10 degrees. Should you find yourself in cold water and are not able to get out, you will be faced with a critical choice: adopt a defensive posture in the water to conserve heat and wait for rescue or attempt to swim to safety.

Swimming or treading water will greatly increase heat loss and can shorten survival time by more than 50%. Even a strong swimmer should not attempt to swim to shore if it is more than 2kms away. Distance to shore is often underestimated. Swimming should only be attempted if clearly close to shore and if water temperature allows.

The major body heat loss areas are the head, neck, armpits, chest and groin. Survivors should, even if out of the water in a raft, huddle together or in groups of about four persons facing each other with upper and lower bodies pressed close together to maintain body heat. Children should be placed in the middle of the huddle.

Figure 3: Heat Escape Lessening Position (HELP)[5]

Source: Maritime NZ

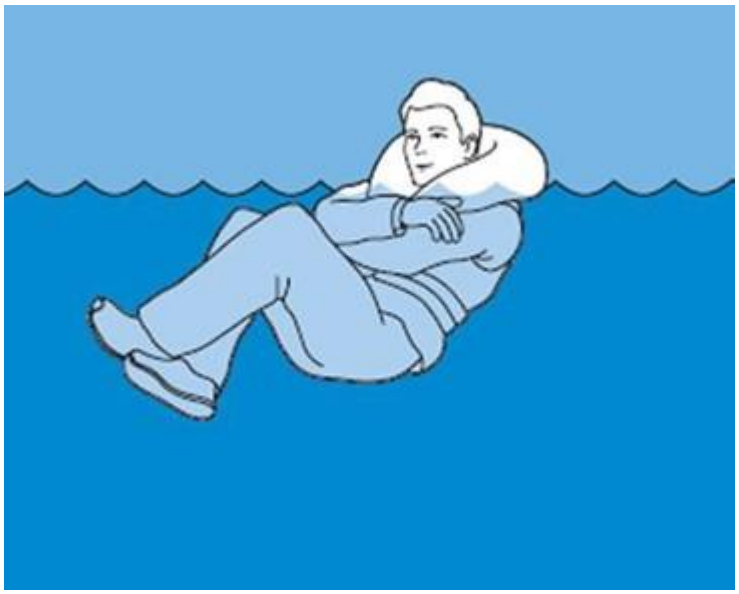
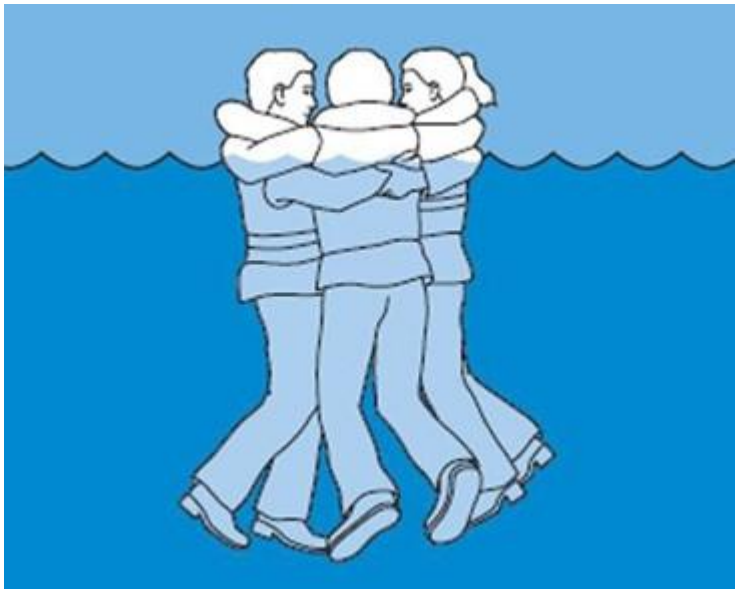


Figure 4: Small group huddle

Source: Maritime NZ



First aid considerations for cold water victims

Treatment for hypothermia depends on the condition of the person. Mild hypothermia victims who show only symptoms of shivering and are capable of rational conversation may only require removal of wet clothes and replacement with dry clothes or blankets.

[5] Maritime NZ, Survive in cold water - Maritime NZ

In more severe cases where the victim is semi-conscious, immediate steps must be taken to begin the re-warming process.

The person should be removed from the water and placed in a warmer environment. Remove the clothing only if it can be done with a minimum of movement of the victim's body. Do not massage the extremities.

Lay the semi-conscious person face up, with the head slightly lowered, unless vomiting occurs. The head down position allows more blood to flow to the brain.

In a ditching situation there will be little or no equipment available. A rescuer may use his or her own body heat to warm a hypothermia victim.

***Note**: If advanced rescue equipment is available, it can be administered by those trained in its use.*

- *Administer warm humidified oxygen by face mask.*
- *Immediately attempt to rewarm the victim's body core. If possible, place the person in a bath of hot water at a temperature of 40 to 43 degrees. It is important that the victim's arms and legs be kept out of the water to prevent "after-drop". After-drop occurs when the cold blood from the limbs is forced back into the body resulting in further lowering of the core temperature. After-drop can be fatal.*
- *If a tub is not available, apply hot, wet towels or blankets to the victim's head, neck, chest, groin, and abdomen. Do not warm the arms or legs. Never give alcohol to a hypothermia victim.*

Some important facts to remember

Most persons recovered in cold water "near drowning" cases show the typical symptoms of death:

(a) cyanotic (blue) skin coloration

(b) no detectable breathing

(c) no apparent pulse or heartbeat

(d) pupils fully dilated.

These symptoms do not necessarily mean that the victim is dead, as they are the body's way of increasing its chances of survival through what scientists call the mammalian diving reflex. This reflex is most evident in marine mammals such as whales, seals or porpoises. In the diving reflex, blood is diverted away from the arms and legs to circulate (at the rate of only six to eight beats per minute, in some cases) between the heart, brain and lungs. Marine mammals have developed this ability to the point where they can remain under water for extended periods of time (over 30 minutes in some species) without brain or body damage.

Humans experience the diving reflex, but it is not as pronounced as in other mammals. The factors which enhance the diving reflex in humans are:

(a) water temperature – at less than 21 degrees, the response is more profound and perhaps more protective to the brain

(b) age – the younger the victim, the more active the reflex

(c) facial immersion – the pathways necessary for stimulating this series of responses seem to emanate from facial cold-water stimulation.

The diving reflex is a protective mechanism for humans in cold water immersions, but it may confuse the rescuer into thinking the victim is dead. Resuscitative efforts for these victims should be started immediately utilising CPR.

The article here reports that "numerous children have been brought up from freezing water after 30 minutes and been successfully resuscitated".

Table 2: Expected Survival Time in Cold Water[6]

Water Temperature	Time to Exhaustion or Unconsciousness	Expected Survival Time
21–27°C (70–80°F)	3–12 hours	3 hours – indefinitely
16–21°C (60–70°F)	2–7 hours	2–40 hours
10–16°C (50–60°F)	1–2 hours	1–6 hours
4–10°C (40–50°F)	30–60 minutes	1–3 hours
0–4°C (32–40°F)	15–30 minutes	30–90 minutes
< 0°C (<32°F)	Under 15 minutes	Less than 45 minutes

7. Carrying survival provisions

Requirements for food

Most doctors agree that a healthy human can go for up to eight weeks without food. People have survived a longer period and been fine, while others have starved to death in less time.

Being in good physical condition can assist in living longer, but so does having extra body fat. The body stores energy it needs to survive in the form of carbohydrates, proteins and fat. Without food coming in the first to be used from the body stores are the carbohydrates, then the fat and last of all the protein. If the body is using protein, it is basically feeding off itself and the situation is becoming critical.

Metabolism plays a part too. A person with a slow metabolism will burn food at a slower rate and be able to survive longer. If no food is consumed the metabolic rate automatically slows down to adjust the rate of fuel burn to make energy stores last longer.

Extreme heat or cold will decrease survival time without food.

Requirements for water

Living without water is very different from living without food. In hot conditions with no water dehydration can set in within an hour. Consequently, for a prepared ditching, the crew should set aside available water bottles to be taken onboard the raft.

[6] These survival times are guidelines for the average adult wearing a life preserver. This table is from the United States Search and Rescue Task Force web site - http://www.ussartf.org/cold_water_survival.htm

Humans lose water through sweat, urine, faeces, and breathing. This water needs to be replaced so the organs can work properly. In severe heat an adult can lose as much as 1.5 litres of water through sweat alone per day.

In average weather conditions, and at a reasonable level of physical fitness, humans can live for three to five days without water. An average human needs about two litres of water per day.

There are some useful websites in the *Further Reading* section, below.

Points to Remember

Carry sea-sickness medicine and, where appropriate, administer it straight away. Most people will succumb to sea sickness quickly, which leads to dehydration.

UV exposure also needs to be managed – stay under cover or apply sunscreen (if available).

The USMC Marine Combat Water Survival Manual states the following rules:

- DO NOT drink saltwater.
- DO NOT drink urine.
- DO NOT drink alcohol.
- DO NOT smoke.
- DO NOT EAT unless water is available.

A study of shipwrecked sailors from World War Two and sea water drinking by the US Navy found:

Table 3: Mortality rates for drinkers of sea water

	Total number	Number who died	Death rate
Those that drank sea water	997	387	38.3%
Those that did not drink seawater	3,994	133	3.3%

This suggests that it is critical to carry enough drinking water when flying over water for each person on board. The emergency supplies need to be in containers that can be easily removed from the aircraft if required for use. How much water will depend on the outcome of the pre-flight risk analysis which should consider all the factors surrounding rescue from the most inaccessible point along the proposed track.

8. Further Reading

Advisory Circulars

Civil Aviation Safety Authority Australia:

- *Ditching*, advisory-circular-91-09-ditching (1).pdf

Transport Canada:

- *Demonstration of Emergency Evacuation and Ditching Procedures – Airline Operations,* Advisory Circular (AC) No. 705-009 (canada.ca)

CAANZ:

- AC100-1, *Safety Management*

In particular, *Section 2.3.2 Element 5: Risk Management* for advice on Safety Management/Risk and setting up a continuous improvement system

- AC121-6, *Occupancy of Emergency Exit Rows*

ICAO Manuals

ICAO Doc 10002, Cabin Crew Safety Training Manual, in particular Chapter 5, Abnormal and emergency situations training
https://store.icao.int/en/cabin-crew-safety-training-manual-doc-10002

ICAO Doc 9868 Procedures For Air Navigation Services - Training
https://store.icao.int/en/procedures-for-air-navigation-services-training-doc-9868

ICAO Doc 9859, Safety Management Manual
https://store.icao.int/en/safety-management-manual-doc-9859

ICAO Safety Management Manual Doc 9859 | SKYbrary Aviation Safety

FAA documents

FAA Safety System Handbook, System Safety Handbook (fdlp.gov)

Aeronautical Information Manual

- https://www.faa.gov/air_traffic/publications/media/aim_bsc_w_chg_1_2_and_3_dtd_11-03-22.pdf

SKYbrary

Ditching: Fixed Wing Aircraft | SKYbrary Aviation Safety

Waterproof Flight Operations (skybrary.aero)

Emergency Evacuation on Water | SKYbrary Aviation Safety

survival_eng.qxd (skybrary.aero)

Maritime NZ

Survive in cold water - Maritime NZ

Other sources

How long can you live without water? Facts and effects (medicalnewstoday.com)

How Long Can You Live Without Water? Effects of Dehydration (healthline.com)

How Long Can You Survive Or Live Without Water? (scienceabc.com)

CABIN CREW TRAINING: DITCHING - LONG (FULL) PREPARATION - YouTube

Appendix – Suggested checklists

Pilot checklist[7]

1. Before long over-water flights, review plans for ditching and subsequent survival, establish what rescue services are available and how to optimise their usefulness.

2. The following suggested checklist is provided for consideration and customisation. It is not designed for specific aircraft or any specific operation. Operators are recommended to make their own checklist (in conjunction with the aircraft manufacturer's checklists) that includes the considerations raised previously and the general information provided in this checklist:

    a. Plan to ditch using power if available.

    b. Look for likely rescue sources—ships, shorelines.

    c. Make Mayday calls, set transponder code to 7700.

    d. Study the wind and sea surface, then make a plan of action for the direction of the ditching manoeuvre.

    e. Burn off or jettison fuel, if possible, to ensure the aircraft is as light as practicable.

    f. Jettison (i.e. dump) any freight and other unnecessary heavy objects if possible.

    g. Brief all crew and passengers, covering their actions and responsibilities before and after the ditching event, including the use of a life jacket.

    h. Ensure all survival equipment is readily accessible, including ELBs.

    i. Ensure there are no loose objects anywhere in the cockpit or cabin.

    j. Conduct pre-landing checks and leave undercarriage up unless it is advised to do otherwise.

    k. Select an intermediate amount of flap to optimise lift, but not providing high drag unless advised otherwise.

    l. Wedge open some doors or hatches (depending on aircraft type and manufacturer suggested procedures).

    m. Assess the wind, swell and wave direction to decide on the final direction of ditching.

    n. Set up the final approach not below 500 ft above the surface.

[7] CASA AC91-09, *Ditching*

o. Unless the aircraft manufacturer recommends the contrary, if possible, accurately judge the height of the aircraft above the water, ensure rate of descent is less than 200 ft per minute, round out at the usual flare height and hold off until impact, wings parallel with the sea surface (level for a calm surface).

p. After the aircraft stops immediate post-impact movement, vacate, taking all necessary gear.

q. Only inflate the life jacket when outside the aircraft.

Crew Checklist

As well as the pilot checklist, cabin crew need their own checklist.

In a prepared ditching, remember to:

- Instruct ABPs on life raft removal from where it is stowed
- Ensure special category passengers understand what they need to do
- Show the location of
  - portable ELTs and
  - exits, and
- Cover how to do the brace position
- Clarify lifejackets can be donned (not inflated) and Infant life jackets given out and donned, and
- Set aside available water bottles that can be taken onboard the raft.

In an unprepared ditching, ensure:

- Special category passengers understand what they need to do
- Life jackets and infants' life jackets are given out
- Rafts are launched, and
- Crew take assigned equipment when exiting.

Checklist of questions when assessing potential training facilities

When assessing a training provider, the following questions may be useful:

- What aircraft are they training the wet drills for at this facility?
- What life raft is/are the aircraft equipped with?
- Have the trainers completed a facility site inspection at the facility?
- Do they have a report with pictures to show it is fit for your training purposes?

- Does the facility provide support services as required?
- Is the pool adequate for the number of trainees, size of life raft and your other requirements?
- Is the platform height that crew will be jumping from representative?
- Is there adequate space to simulate launching the life raft from the aircraft?
- Is there adequate lighting?
- Does the facility have a lockable area for equipment you will provide?
- What equipment is provided by the facility?
- Is the training equipment provided by the organisation providing training equivalent to what is onboard your aircraft?
- Do they have a list of all the required training aids and who is responsible for ensuring they are at the training?
- Where is their procedure for using this training facility?