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Loss of directional control during water landing, Consolidated PBY-5A Catalina

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The Hague, December 2018

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Cover photo: John Redeker

The Dutch Safety Board

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N.B. This report is published in the English language with a separate Dutch summary. If there is a difference in interpretation between the report and the summary, the report text wil prevail.

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Identification number:	2017086
Classification:	Serious incident
Date, time[1] of occurrence:	15 August 2017, approximately 14.15 hours
Location of occurrence:	IJsselmeer, near Lelystad, the Netherlands
Aircraft registration:	PH-PBY
Aircraft model:	Consolidated PBY-5A Catalina
Type of aircraft:	Twin engine amphibious
Type of flight:	Memorial flight followed by touch-and-go on water
Phase of operation:	Landing
Damage to aircraft:	Minor
Cockpit crew:	Two
Cabin crew:	One
Passengers:	Fifteen
Injuries:	None
Other damage:	None
Lighting conditions:	Daylight

1 All times given in this report are local unless stated otherwise.

SUMMARY

After a flight of almost two hours a planned 'splash-and-go' manoeuvre (a water landing with immediate subsequent take-off) was carried out on the IJsselmeer, near Lelystad. During this manoeuvre, initially directional control difficulties were experienced. When returning to Lelystad Airport, the flight crew noticed that the left-hand nose wheel door was missing and the nose landing gear failed to extend. The alternate (manual) gear extension procedure also failed to extend the nose wheel and the flight crew was forced to make a nose wheel up landing, which was executed successfully. The damage resulting from the water landing was limited to the nose gear construction and its doors. As a result of the nose wheel up landing at the airport, the nose section of the aircraft was damaged. The 18 occupants were not injured.

Conclusions

After touchdown on the water, the aircraft initially veered severely to the left, most likely as a result of a deformed left-hand nose gear door that eventually broke off. The extent and cause of the deformation is unknown since the door was not recovered. As a result of the deformation of the door, the door's lock pin was bent and since both left-hand and right-hand door pins are mechanically connected, the right hand door could not be opened.

The flight crew's decision not to reject the take-off was likely influenced by earlier accidents with the same type of aircraft in which the aircraft sank.

Because the right-hand nose wheel door remained closed, the nose gear could not be extended and the flight crew was forced to make a nose wheel up landing on the ground, which was executed successfully.

History of the flight

The crew of the Consolidated PBY-5A Catalina was carrying out a cross country flight from Lelystad Airport. The purpose of the flight was a memorial fly-by over the Indonesian monument in The Hague, where a commemoration of the Second World War Japanese capitulation was taking place. After a flight of almost two hours a planned '*splash-and-go*' manoeuvre (a water landing with immediate subsequent take-off) was carried out on the IJsselmeer, near Lelystad.

Before the water landing, wind direction and wind speed were checked and an inspection run was performed to look out for ships, buoys and other possible obstacles that might jeopardise the landing. No abnormalities were seen and the crew performed the briefing and the approach checklist. The approach started at 300 feet with an airspeed of 85 knots. Shortly before the water landing the airspeed was reduced to 72 knots. Vertical speed was between 100 and 200 feet/minute. Immediately after hitting the water the aircraft started to turn severely around the vertical axis to the left. The captain, who was pilot flying (PF), ordered full power from the pilot monitoring (PM). Despite full right rudder and aid of the ailerons, the aircraft persisted the left-hand turn. The PM selected asymmetric power to counteract the movement around the vertical axis. After a full 360-degree turn, directional control was suddenly regained after which the PF ordered full power.

The aircraft took off at an airspeed of 65 knots. After passing 500 feet during the climb, both pilots noticed via an inspection hatch that the left hand nose wheel door was missing. At an altitude of 1,000 feet the aircraft headed back to Lelystad Airport. The landing gear was lowered but only the two main gears were extended and locked. The right-hand nose wheel door remained closed and the nose wheel stayed inside the wheel bay. Recycling of the landing gear had no result and Lelystad Radio was informed about a possible nose wheel up landing. The PM made an attempt to use the alternate (manual) gear extension procedure to lower the nose gear but failed at the first step of the procedure: opening the right-hand wheel door. The crew was aware that a nose wheel up landing was inevitable and informed Lelystad Radio. The landing was well executed by keeping the nose up for as long as possible. The aircraft came to a standstill just left of the centre line. All 18 occupants left the aircraft uninjured.

The damage resulting from the water landing was limited to the nose gear construction and its doors. As a result of the nose wheel up landing at the airport, the nose section of the aircraft was damaged.

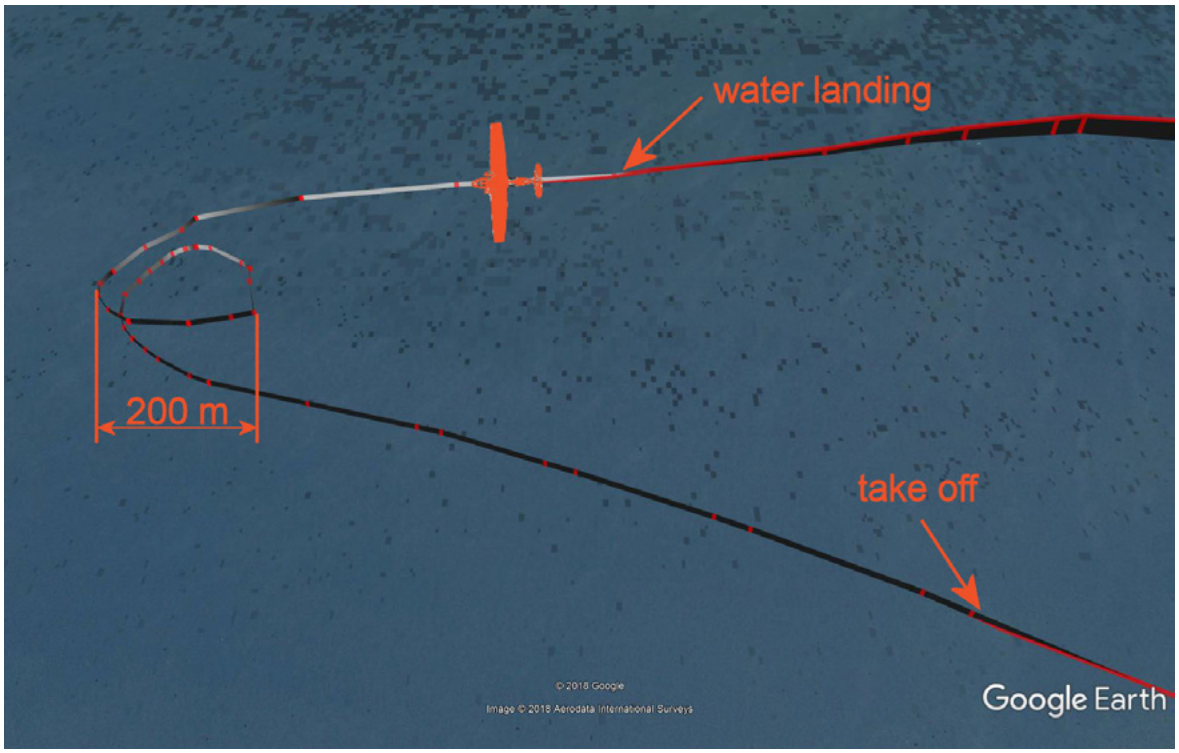

Figure 1: Track of PH-PBY on the water, based on GPS recording. (Source: PBY Catalina Foundation)

Personnel Information

Captain	
Number of hours total	20,700
Number of hours on Consolidated PBY-5A Catalina	290
Number of water landings on Consolidated PBY-5A Catalina	512

Table 1: Flying experience captain.

Co-pilot:	
Number of hours total	8,200
Number of hours on Consolidated PBY-5A Catalina	55
Number of water landings on Consolidated PBY-5A Catalina	75

Table 2: Flying experience co-pilot.

Aircraft information

The Consolidated PBY-5A Catalina, or Catalina for short, is an amphibious aircraft of the 1930s and 1940s produced by Consolidated Aircraft (USA). It can operate both on water and runways and was one of the most widely used seaplanes during World War II. Catalina's served in every branch of the United States Armed Forces and in the air forces and navies of many other countries. During the Second World War and thereafter, the Royal Dutch Navy operated approximately 80 Catalina's.

More than 4,000 Catalina's were built in different models. Nowadays, less than ten Catalina's are still in service worldwide. PH-PBY rolled out of the factory in November 1941 and was in use in the United States Navy as number 2459. PH-PBY is the only flying Catalina based in the Netherlands. The boat shaped fuselage makes the airplane suitable for water landings. For landings on runways, two main landing gears and a nose landing gear can be extended. The aircraft is further equipped with transparent domes on either side of the fuselage for observation purposes.

The Catalina is powered by two radial piston engines of 880 kW each. The aircraft has a wingspan of 31.72 metres and a length of 19.84 metres. The cruise speed is 253 km/h with a maximum speed of 320 km/h.

Figure 2: Archive photo of PH-PBY. (Source: John Redeker)

Nose gear doors investigation

The aircraft is equipped with two nose gear doors, one on either side. When closed, the doors are flush with the fuselage to minimise drag both in flight and on the water. Through a viewer in the cockpit, the flight crew can check that the doors are closed prior to a water landing. This is part of the water landing procedure.

Figure 3: Nose wheel doors open. (Source: Airplane-Pictures.net / Alistair Bridges)

Figure 4: Nose wheel doors closed. (Source: nustyR)

The doors are operated by a hydraulic cylinder which is mechanically connected to two torque tubes, one for each door (see Figure 5).

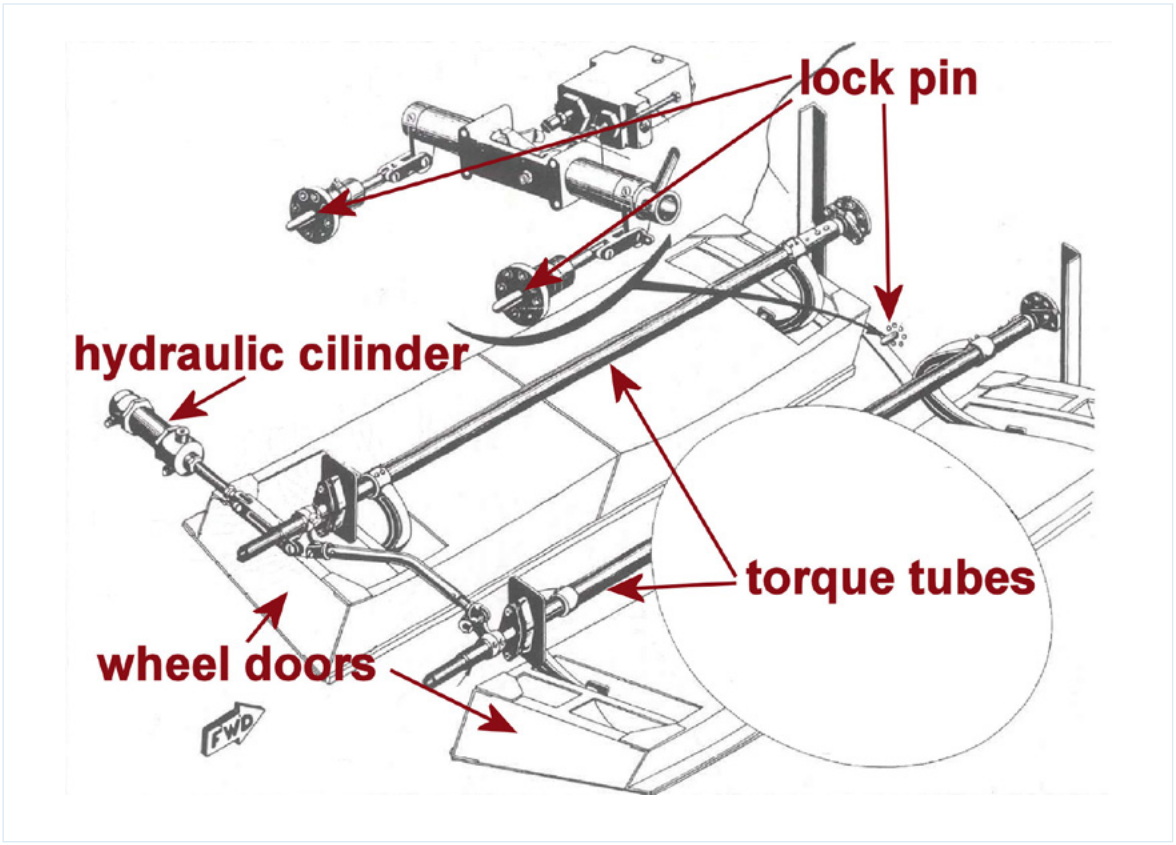

Figure 5: Nose wheel door control mechanism. (Source: Aircraft Maintenance Manual)

When pressure is applied to the hydraulic cylinder the torque tubes start to rotate and open or close the corresponding wheel doors. Before the doors can be opened, a lock pin on each door must be retracted. When the lock pins are not retracted, the doors remain closed and the nose wheel cannot be lowered. During inspection of the nose gear mechanism of PH-PBY, the flight crew's initial findings were confirmed: the left-hand door was missing completely. Besides the missing door it was discovered that the left-hand lock pin was bent in the extended (locked) position (see Figures 6 and 7).

Figure 6: Bent left hand lock pin. (Source: Dutch Safety Board)

Figure 7: Disassembled left-hand lock pin. (Source: Dutch Safety Board)

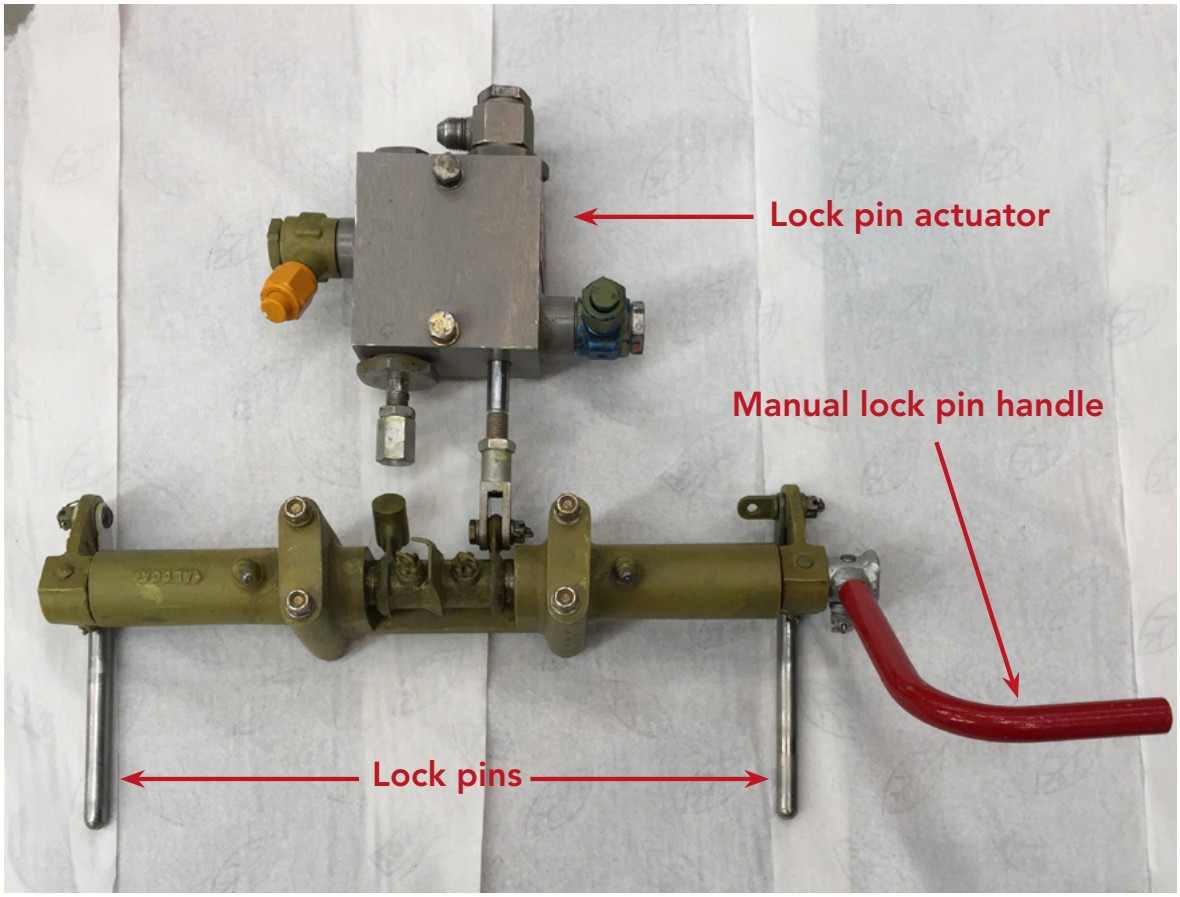

Figure 8: Lock pin mechanism (note that the bent left-hand pin has been replaced). (Source: Dutch Safety Board)

When the flight crew attempted to lower the nose gear, the bend prevented the pin from retracting. Because both lock pins are mechanically connected, also the right hand lock pin remained in the extended (locked) position and prevented the right-hand wheel door from opening. With a closed wheel door the nose gear could not be lowered. This forced the flight crew to make a nose wheel up landing.

Most likely sequence of events and probable cause

When the aircraft touched down on the water, a great force pushed the nose of the aircraft to the left. The force was most likely generated by a deformed left-hand nose gear door scooping water and acting as a water rudder. Since the density of water is more than 700 times the density of air, the flight crew was unable to counteract the force with its rudder and ailerons.

A search for the door was performed but it was not found. As the door was not recovered and could not be investigated, the extent and cause of the deformation of the left-hand door remains unknown. Possible causes, such as the doors not having been shut completely before the water landing or that the nose gear door hit a piece of debris in the water could therefore not be confirmed.

After a more than 360-degree turn on the water, the left-hand wheel door was most likely ripped off. This caused the movement to the left to stop. The flight crew then managed to regain control of the aircraft, increased speed and took off. The bending of the left-hand lock pin most likely occurred when the door broke off.

Crew actions after touch down

It can be discussed whether the flight crew, in hind sight, made the right decision not to abandon the water take off. In this particular case the crew was fortunate that the wheel door broke off completely resulting in regaining directional control. The crew was aware of earlier accidents with the same type of civil registered aircraft in which a broken nose wheel door caused the aircraft to sink. In one case this resulted in a fatal accident. With this in mind, it is understandable that the crew tried to take off from the water again instead of letting the aircraft come to rest on the water, risking a ground loop or even overturning. During the take-off the crew tried to keep the nose up as much as possible, in order to prevent contact of the nose wheel doors with the water. In this particular case, taking off again turned out to be a good decision.

Safety actions after the event

The Catalina foundation organised an internal meeting to discuss the probable cause of the directional control problems and the crew's actions to cope with the situation. As a result, mitigating actions were proposed, consisting of both operational and technical measures. The technical measures focus on the confirmation – as part of the pre-flight check – that the nose wheel doors are completely closed.

Operational measures

The operator intends to amend the Aircraft Operating Manual (AOM), part B, with the following:

- If any doubt exists during any part of the approach, either due to unfamiliar sounds or trembling of the aircraft, the approach shall be discontinued and further investigation must take place as to establish the nature of these phenomena.
- If after touch down on the water, the aircraft has a tendency to yaw, this might be the result of drag caused by nose wheel doors not being flush with the aircraft fuselage.
- All available means must be used including combinations of full rudder and ailerons and if necessary asymmetrical power, to regain control. If possible, the nose gear area must be held above the water to reduce drag.
- Regarding the circumstances a full stop shall be avoided. When the aircraft is airborne again, no more water landings shall be attempted and a full stop on terrain shall be made as soon as practicable in order to investigate the cause.

- The crew briefing for a water landing, either full stop or 'splash-and-go' should at least cover the following:
  - The appropriate speed at touchdown (73 knots).
  - The intended landing spot, considering obstacles such as markers, fishing nets, ships and in particular their wake, keeping in mind that a wake can travel long distances, especially in glassy water.
  - Any obstacles such as terrain in the area of the intended climb out after the 'splash-and-go'.

Technical measures

- The operator is intending to mount sensors near both lock pins and an indicator in the cockpit to enable the flight crew to check the status of the pins (locked or unlocked).
- Two small bluetooth cameras will be installed in the nose wheel bay and linked to an iPad in the cockpit to check if the nose wheel doors are closed completely.
- Deflector spoilers will be fitted to the fuselage to deflect the full water force from the front of the nose wheel doors.

Apart from the measures mentioned above, a thorough risk assessment for each water landing appears to be a necessity. This applies in particular when flying with passengers, due to the additional risks during a possible evacuation.

CONCLUSIONS

After touch down on the water, the aircraft initially veered severely to the left, most likely as a result of a deformed left-hand nose gear door that eventually broke off. The extent and cause of the deformation is unknown since the door was not recovered. As a result of the deformation of the door, the door's lock pin was bent. Since both left-hand and right-hand door pins are mechanically connected, the right-hand door could not be opened.

The flight crew's decision not to reject the take-off was likely influenced by earlier accidents with the same type of aircraft in which the aircraft sank.

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