



Australian Government

Australian Transport Safety Bureau

Main rotor anti-flap stop failure involving Sikorsky S-92, VH-ZUQ

Broome Airport, Western Australia, 10 November 2016

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Addendum

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Main rotor anti-flap stop failure involving Sikorsky S-92, VH-ZUQ

What happened

On 10 November 2016, a Sikorsky S-92A helicopter, registered VH-ZUQ (ZUQ), was scheduled to fly from Broome Airport, WA, to an offshore facility. The flight crew consisted of a pilot flying (PF) in the right crew seat, and pilot monitoring (PM) in the left crew seat¹. The PM was undergoing conversion training on the S-92A.

During the start procedure, the flight crew reported feeling abnormal vibrations in the airframe. The crew believed this might have been the result of a crosswind or recent maintenance work performed on the aircraft, and the PF attempted to minimise it by adjusting the cyclic control.

At approximately 1215 Western Standard Time (WST), a member of the ground crew showed the pilots an anti-flap stop that had broken off the main rotor head. Figure 1 shows the recovered anti-flap stop and securing hardware. Figure 2 shows the anti-flap stop attached to the main rotor hub. The helicopter was subsequently shut down. Further inspection revealed that two anti-flap stops had been sheared off the main rotor head during start-up. One of the stops landed next to the aircraft, while the other struck one of the main rotor blades and narrowly missed a member of the ground crew. It was recovered 45 metres from the aircraft.

Figure 1: Anti-flap stop and securing hardware.



Source: Operator

¹ While roles may vary between operations, the pilot flying is primarily responsible for handling the aircraft. The pilot monitoring monitors the pilot flying and is usually responsible for other tasks such as radio calls.

Figure 2: Anti-flap stop secured to the main rotor hub.



Source: Operator

The damage to the anti-flap stops was found to have been the result of the PM not lowering the collective control lever at the appropriate time during the engine start. The raised collective resulted in the blades lifting upward, placing abnormal stresses on the anti-flap stops (which are designed to limit upward movement of the blades). This behaviour resulted in the vibrations experienced by the crew.

Events leading up to the broken anti-flap stops

The flight crew had flown together on each of the three days leading up to the serious incident. In all three flights, the pilots were acting in the opposite roles compared with the incident flight. The PM on the day of the incident had never flown an S-92 in that role before.

On the day of the serious incident, the crew arrived approximately two hours before the scheduled take-off. This was in accordance with base instructions that required at least 90 minutes for flight planning and pre-flight inspections. However, the PM was required to make a phone call to the company's flight operations department and the crew were then involved in a discussion regarding the PM's further training requirements.

The flight crew were also required to 'shadow plan'² and perform the pre-flight inspection on a second aircraft, to ensure the flight could proceed in the event that ZUQ was unable to fly. According to the operator's daily flying roster, the base pilot-in-command (PIC) was originally rostered on to be part of the backup crew. However, client obligations on the base prevented the PIC from being available in the event of the backup crew being required. The PF and PM were not aware of this prior to arriving that day, so they had not given themselves additional time to prepare a second aircraft before departure.

Prior to departure, the PF was tasked with pre-flight inspections of ZUQ as well as the backup aircraft, but they were delayed as maintenance activities were still being conducted on ZUQ. In addition, flight data from ZUQ's previous flight had not yet been downloaded and analysed, further delaying the PF.

Flight crew comments

Both the PF and PM felt time pressure compounding from the morning's events. Given that, in accordance with the base rules, 90 minutes is required to prepare for a single flight and

² Shadow planning refers to creating a completely separate flight plan for another aircraft.

considering the number of distractions and delays encountered that morning, the crew felt that more time was required to adequately plan and prepare for both flights. As a result of feeling rushed and to ensure that they were fully prepared for the flight, they completed a second threat and error review, rechecked the flight plan together, rechecked the helicopter's technical log and walked to the helicopter together.

The flight crew perceived a significant amount of pressure from the operator's client for this flight. They believed that this client, more than any other they were aware of, required flights to adhere to strict schedules.

Engine start procedures

For engine starts with the rotor brake off, as were normally performed by this operator, the collective must be lowered as part of the start sequence. According to the operator's standard operating procedures, the PF starts the number 1 engine first, and brings the throttle to idle. When the rotational speed of the main rotor is over 20%, and the hydraulic pressure reaches an appropriate level, the procedures state that the collective is to be moved to the full down position. The PF then starts the number 2 engine.

The S-92A was the only helicopter in the operator's fleet that required the collective to be lowered as part of the start sequence. It was also the only helicopter where responsibility for controls was split between the two pilots. The operator's procedures did not designate the task of lowering the collective to either the PM or PF. However, the operator's parent company uses procedures that specifically assign the role to the PM. Despite not being contained in the operator's procedures, both pilots understood that it was the role of the PM to lower the collective during engine start and this had been briefed prior to the engine start.

Operator's investigation

Immediately after the serious incident, the operator commenced its own safety investigation. It identified that the PM had not lowered the collective at the appropriate time during the start procedure. A number of factors were identified. Some of these are listed below:

- Within the operator's fleet, the requirement that the PM, rather than the PF, lower the collective is unique to the S-92A.
- During the S-92A start procedure, there is no documented requirement for a call out and challenged response between the flight crew to ensure the collective is lowered.
- The PM had been serving as PF for the last three flights the crew carried out together.

Safety analysis

Almost immediately after they arrived at work in the morning, the flight crew began experiencing steadily increasing time pressure. The crew had more work than expected which resulted in less time in which to plan their flight. This pressure was great enough that the flight crew discussed it prior to the flight.

On the incident flight, the PM was flying for their first time in that particular role on a S-92A. This meant that the PM had never been tasked with lowering the collective on a S-92A during start-up. This was the first helicopter that the PM had flown where the responsibility for controls (collective, cyclic and anti-torque pedals) was split between the two pilots. In addition, there were no other helicopters in the operator's fleet in which the collective must be lowered during the start-up procedure. The PM's lack of experience in this particular role may have contributed to the collective not being lowered at the appropriate time.

The operator's standard operating procedures required the collective to be lowered during the start-up procedure. However, there was no requirement on either pilot to "call out" in order to

check/verify the collective position. If a call out had been required by the procedures, it is possible that the PF would have noticed it had not been lowered and the incident might have been avoided.

There was no division of labour specified between the PF and PM in the operator's documentation. In this particular instance, both the PF and PM were aware of their responsibilities prior to start-up, so this likely did not contribute to the incident. However, this ambiguity in the operator's procedure has the potential to cause similar problems in future.

Findings

- A series of events resulted in the flight crew having more tasks to complete than originally planned, and less time in which to complete them. This resulted in time pressure on the crew.
- The PM's unfamiliarity with the unique starting procedures in the S-92A compared with other helicopters contributed to the collective not being lowered in time.
- The operator's standard operating procedures did not require any call outs for the lowering of the collective, which probably contributed to the collective not being lowered in time.
- With regard to start-up, the operator's standard operating procedures do not provide an explicit division of tasks between the PF and PM.

Safety action

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence.

The Operator

The operator's investigation into this incident produced 17 recommendations, some of which include:

- a review of S-92A start procedures, addressing as a minimum:
 - flight crew division of duties with specific regard for the collective control lever
 - standardised calls relating to the position of the collective control lever
 - the use of the rotor brake for the start procedure³
- changes to the engine start procedures, the section on lowering the collective is currently written in a 'Note', this will be changed to a 'Caution' to highlight its importance to flight crew
- a review of the policy and procedures used for shadow planning be undertaken, addressing as a minimum all hazards and risks associated with shadow planning inclusive of whether flight crew undergoing training should be exposed to the requirement.

Safety message

This incident is an example of what can occur when pressure associated with on-time departures is compounded with the absence of clear operating procedures. It is important that pilots have detailed and specific instructions on which to fall back when they feel pressure beginning to build.

³ Rotor brake starts make it easier for a single pilot to operate all controls, as the engines can be started before control input is required.

General details

Occurrence details

Date and time:	10 November 2016 – 1215 WST	
Occurrence category:	Serious incident	
Primary occurrence type:	Incorrect configuration	
Location:	Broome Aerodrome	
	Latitude: 17° 56.98' S	Longitude: 122° 13.67' E

Aircraft details

Manufacturer and model:	Sikorsky Aircraft S-92A	
Registration:	VH-ZUQ	
Serial number:	920205	
Type of operation:	Charter	
Persons on board:	Crew – 2	Passengers – 0
Injuries:	Crew – 0	Passengers – 0
Aircraft damage:	Minor	

About the ATSB

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; and fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

About this report

Decisions regarding whether to conduct an investigation, and the scope of an investigation, are based on many factors, including the level of safety benefit likely to be obtained from an investigation. For this occurrence, a limited-scope, fact-gathering investigation was conducted in order to produce a short summary report, and allow for greater industry awareness of potential safety issues and possible safety actions.