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Australian Transport Safety Bureau

Winching event involving Sikorsky S-92A, VH-IPE

near Broome, Western Australia, 26 August 2017

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Addendum

Page	Change	Date

Winching event involving Sikorsky S-92A, VH-IPE

What happened

On 26 August 2017, at about 1100 Western Standard Time,[1] the crew of a Sikorsky S-92A helicopter, registered VH-IPE, were undertaking a winching exercise to a vessel offshore, near Broome, Western Australia. During the exercise, a fracture of the hi-line weak-link resulted in a near contact of the winch hook with the helicopter main rotor. There were no injuries and the helicopter was not damaged.

There were two flight crew, two aircrewman and one rescue crewman on board the helicopter and one rescue crewman on the vessel at the time of the serious incident. The flight crew were employees of Helicopters New Zealand (HNZ - Australia) and the technical crew[2] were employees of Careflight Australia.[3] The flight was a standardisation check flight for one of the aircrewman in his role of winch operator. The other aircrewman was the instructor conducting the assessment. At the time of the incident the operator was in the training and development phase prior to the commencement of a contracted search and rescue service.

The crew conducted a flight brief before departing Broome at about 1030 to rendezvous with a vessel for their deck winching evolutions.[4] The brief included plans for dealing with major and minor helicopter malfunctions while winching, and concluded with an overall risk assessment score of low, which was calculated in accordance with the operator's risk scoring system.

After they rendezvoused with the vessel, the crew set up for the first evolution, which was planned to be a stretcher winch using the hi-line (refer to section titled *Role equipment*).[5] On the first winch, one rescue crewman, with the hi-line bag, was transferred to the vessel with the instructor acting as winch operator for his own currency. As soon as the winch operator received the signal from the rescue crewman that he was safely on deck and disconnected from the winch hook, the winch operator called to the pilot flying (captain in the right seat) that the helicopter was clear to move back to the rest position.[6]

The helicopter started to move left, away from the transfer point. At the same time, the winch operator was slowly winching in and monitoring the line, which was paying out[7] from the hi-line bag. When the helicopter was just clear of the deck, but still moving to the left, with about 30 ft (9 m) of winch cable still extended, a restriction of the line inside the hi-line bag occurred. The hi-line bag flicked up from the deck around the rescue crewman's waist and applied additional tension to the weak-link (the weak-link connected the line to the winch hook – refer to section titled *Role equipment*).[8]

The weak-link immediately fractured and the release of the additional tension sent the winch hook on a near vertical trajectory towards the helicopter's main rotor disc. The winch cable snatched out

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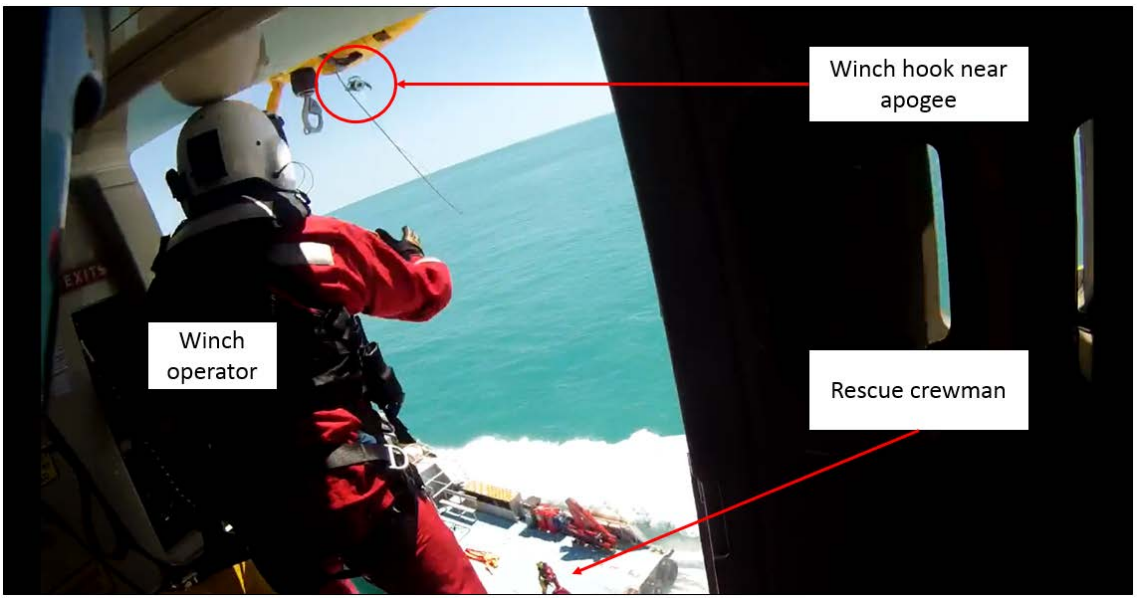
1 Western Standard Time (WST): Coordinated Universal Time (UTC) + 8 hours.
2 Technical crew refers to aircrewman and rescue crewman (paramedics).
3 Reference to operator in this report refers to HNZ (Australia).
4 A winch evolution refers to the entire sequence of winching events to accomplish a goal, such as the recovery of an injured person. It may be performed for training, or assessment, or a real-world task.
5 A hi-line winch transfer involves the majority of the winching evolution being conducted with the helicopter clear of the vessel in the rest position. This requires personnel being on the deck to assist in the recovery.
6 The rest position may vary with the specific conditions and vessel, but for the incident flight was about two rotor diameters from the rear left quarter of the vessel.
7 Let out a rope by slackening it.
8 The purpose of the weak-link is to separate the winch cable from the line in the event that the line becomes entangled.

of the winch operator's hand and the hook reached its apogee[9] at about the height of the winch[10] before falling down (Figure 1).

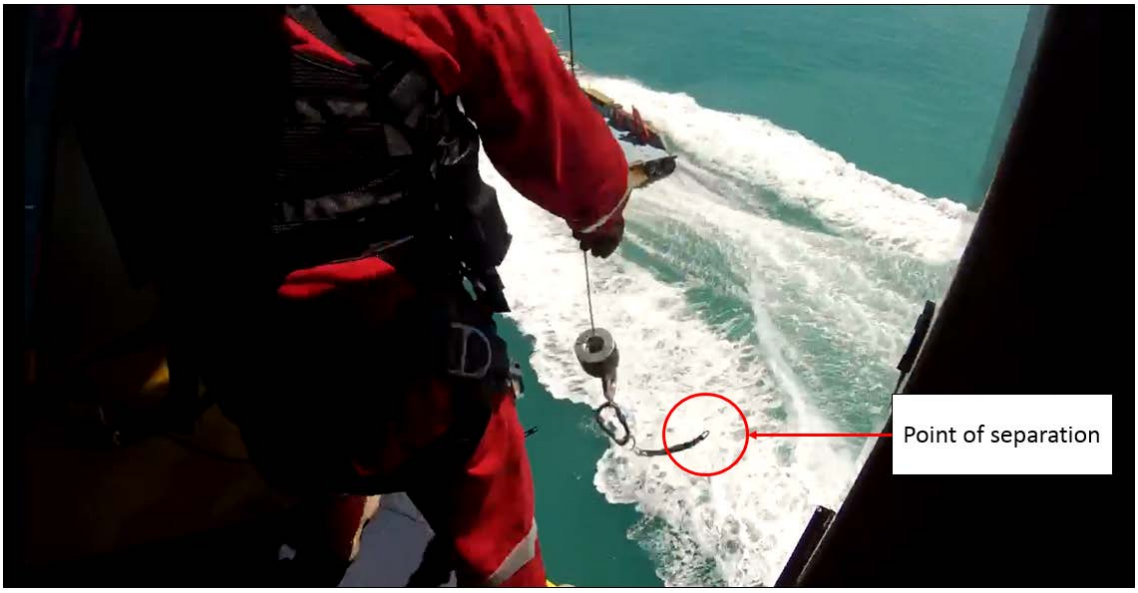
Figure 1: Winch hook near apogee



Source: Winch operator, modified by the ATSB

The pilot flying observed the hook appear at about the height of the winch before the winch operator had time to warn the rest of the crew.[11] After the winch operator regained control of the cable the helicopter returned to the rest position. The winch operator was then able to inspect the cable and debrief the crew about the incident. On retrieval of the hook, the winch operator noted the weak-link had separated at the line end (Figure 2).

Figure 2: Weak-link point of separation



Source: Winch operator, modified by the ATSB

9 Highest point of the trajectory.

10 The helicopter was fitted with a dual winch (hoist). The outboard winch was in use for the incident evolution.

11 The flying pilot's hover reference was the vessel and therefore the hook trajectory was within his field of view.

The crew completed an incident debrief clear of the vessel and elected to complete the flight with open water winching and discontinue further use of the hi-line.[12] The flight was completed and the helicopter returned to Broome without further incident.

Post-incident management response

On completion of the flight, the captain submitted an incident report and Careflight's chief aircrewman directed their personnel to remove the Priority 1 weak-link (refer to section titled *Role equipment*) from the operation. On 28 August, the operator's head of flight operations directed a temporary halt to winch training pending an initial investigation and notified the Civil Aviation Safety Authority (CASA) of that decision. On that same day, Careflight removed the Priority 1 weak-link from their other operations.

On 6 September, the operator's head of training and checking issued a training instruction to prohibit use of the hi-line and weak-link in winch training evolutions until the investigation could develop recommendations. That same day, the head of flight operations notified CASA of the decision to resume winch training in a limited form on 7 September. That limited form was for winch evolutions that did not require the use of hi-line equipment and would continue until such time that the main recommendations from the final investigation were implemented.

Operator's procedures

The operator's search and rescue operations manual, issue 1.1, was published on 25 July 2017. The transfer of the rescue crewman with hi-line to the vessel on the incident flight was in accordance with the operator's procedure 7.7.4: *Insertion/Extraction – Vessel Winching*. The manual also included crew duties, responsibilities and qualifications.

Crew training and qualifications

The flight crew held the appropriate CASA type ratings for SK92 (S-92A) and low level ratings for helicopters and winching. The aircrewman instructor held a CASA approval to conduct training for helicopter winching for the operator in the S-92A in accordance with their procedures. The rescue crewman on the vessel was trained in accordance with the operator's requirements. This included deck winching with hi-line on 15 August 2017, followed by a line-check for the operator on 17 August 2017, which included an unattended stretcher winch from a vessel.[13]

Role equipment

The hi-line is a device used to assist in managing the helicopter's winch hook to a specific area when the helicopter is unable to either position, or remain in position, directly over the transfer point. It is also used as an anti-spin/anti-swing device by a person on the deck of the vessel when a stretcher is winched down from, or up to, the helicopter.

The hi-line equipment comprised of a hi-line bag, a 300 ft x 15/64 inch (91 m x 6 mm) line (rope) inserted in the bag and a break-away weak-link, which connected the line to the winch hook. The weak-link consisted of a plastic buckle and webbing with plastic D-rings at each end. One end was connected to the line, and the other end was connected to a carabiner, which was connected to the winch hook (Figure 3 left). The incident weak-link had an advertised breaking strength of about 90 pound force (400 N). Figure 3 right depicts the fracture of the weak-link that occurred at the line end.

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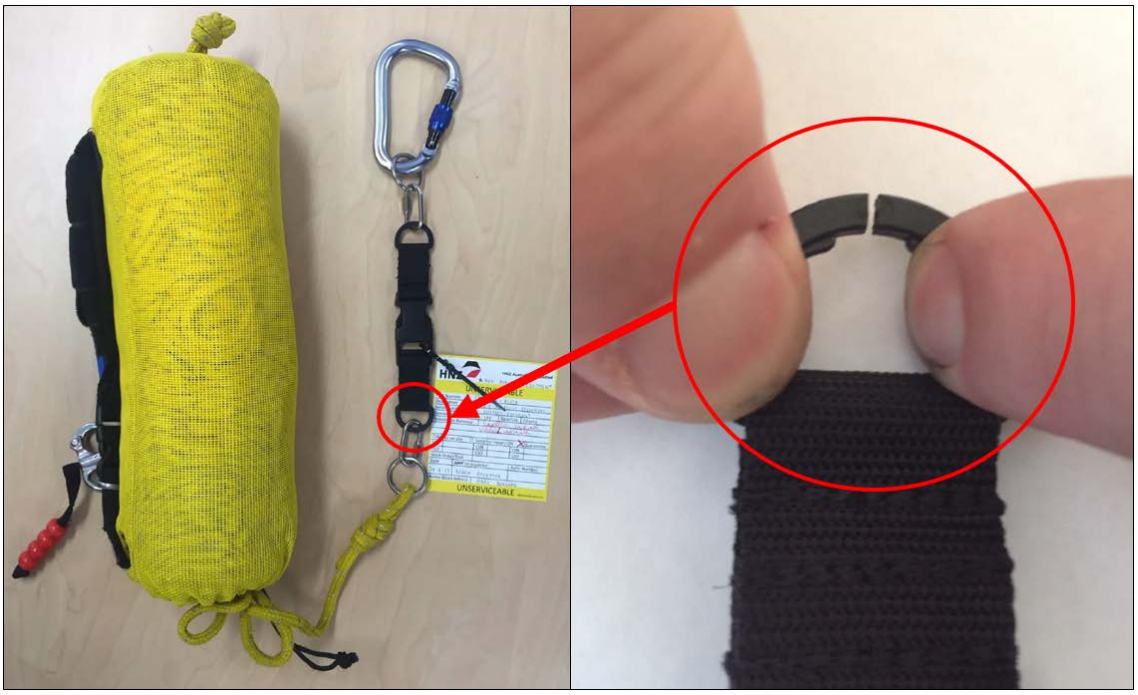
[12] A second weak-link was carried on board the helicopter.

[13] There were no specific competency certification requirements for the rescue crewman in the Civil Aviation Regulations (CAR) 1988. However, their role was that of a 'crew member', as defined in CAR 1988, and CASA considered them to be members of the 'operating crew' as defined in CAR 1988. Therefore, they did not require a certificate of competency under Civil Aviation Order 29.11, but their role, operating procedures, and training and checking requirements were required to be outlined in the operations manual in accordance with CAR 215 and CAR 217.

Figure 3: Hi-line with weak-link and carabiner (left) and fractured weak-link (right)



Source: Operator, modified by the ATSB

The weak-link was manufactured by Priority 1 Air Rescue. They provided training and role equipment for helicopter search and rescue services internationally. The role of the weak link was to break in the event of line entanglement. The low breaking tension on the incident weak-link was a design feature to allow personnel tending the hi-line to break it in an emergency.

The hi-line bag was manufactured by Lifesaving Systems Corporation and could be purchased on its own or with a 75 ft x 3/8 inch (23 m x 9 mm) safety line inserted for use as a water rescue throwline. The bag was provided to the operator by All Elements Protection, the Australian representative for Lifesaving Systems Corporation, to fulfil the need for a netted design to allow water to drain out. A 300 ft (91 m) line was inserted by the operator for the hi-line role. The S-92A main rotor diameter is about 57 ft (17 m). A rest position of about two rotor diameters at 60 ft hover height would therefore require a minimum of 129 ft (39 m) of line. The operator assessed the bag as fit-for-purpose, but also recognised the preference for a larger bag with a wider throat (opening). Therefore, the bag was approved as an interim solution until new alternative hi-line bags arrived.

Following the incident, the instructor commented that he had reservations about the narrow throat on the bag and that internal clumps of rope could result in a restriction. The rescue crewman reported to the operator that it would have been easier to manage the hi-line bag if it had a larger throat, or was a larger bag, or had a shorter line inserted.

Previous incidents

The operator's internal investigation found they had experienced a fracture of a Priority 1 weak-link buckle about 2 weeks prior to the incident flight. This was considered to be due to mishandling and not related to a hi-line evolution. Another operator using the Priority 1 weak-link was contacted by the incident operator and they reported two previous incidents of weak-link fracture. They determined that these were likely the result of crew kneeling on the buckle. After directing their crew to avoid that practice they had not experienced any further fractures.

Management of change

The operator had an integrated management system in place prior to the incident. This comprised of their safety and quality management systems and included a 'management of change'

process.[14] The management of change process was used for the introduction of the search and rescue contracted capability, but did not capture risk assessments of the role equipment.

Safety analysis

Fracture of the weak-link

During the first winch evolution of the flight, the rescue crewman was transferred to the deck of the vessel with the hi-line attached. Once on the deck, the rescue crewman disconnected himself from the winch hook and prepared to pay-out the line as the winch was recovered. As the rescue crewman payed-out the line from the hi-line bag, the helicopter was moving slowly away from the transfer point to the rest position, about two rotor diameters from the vessel. At the same time, the winch operator was slowly retrieving the winch hook while monitoring the rescue crewman's management of the hi-line.

When a restriction of the line inside the hi-line bag occurred, the weak-link was immediately placed under increased tension due to the relative motion of the helicopter and winch cable with respect to the vessel. The tension was sufficient to fracture the weak-link at the line end. The release of the downward tension when the weak-link fractured sent the winch hook on a trajectory towards the helicopter's main rotor disc. The ATSB could not determine if the weak-link fractured at the advertised breaking force, but a notable amount of tension was required to be released to send the winch hook on its trajectory.

Management of change

The helicopter operator was in the training and development stage for their S-92A search and rescue contract, based at Broome. In preparation for the delivery of search and rescue services, they procured search and rescue role equipment from various manufacturers through a third-party agent in Australia. In accordance with their integrated management system, they completed a management of change process for the introduction of the search and rescue capability. However, their management of change did not capture risk assessments for their search and rescue role equipment.

The operator inserted a 300 ft line into a hi-line bag that was advertised as either a stand-alone item, or fitted with a 75 ft line. In addition, the hi-line bag was a sausage shaped bag with a narrow throat relative to the amount of line inserted. Therefore, when assembled, the hi-line equipment presented an increased risk for restrictions during a hi-line evolution and the equipment was no longer fit-for-purpose.

Findings

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

- During the winching evolution with the vessel, the hi-line became restricted inside the hi-line bag, which, combined with the motion of the winch hook relative to the vessel, resulted in sufficient tension on the weak-link to fracture it and send the winch hook on a trajectory towards the helicopter's main rotor disc.
- The operator's management of change for the introduction of the search and rescue contract capability did not capture risk assessments for their role equipment, which resulted in the use of a small hi-line bag with a narrow throat relative to the length of line required for the task.

[14] Change management is defined in the International Civil Aviation Organization safety management manual as: 'A formal process to manage changes within an organization in a systematic manner, so that changes which may impact identified hazards and risk mitigation strategies are accounted for, before the implementation of such changes.'

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.

Operator

As a result of this occurrence, HNZ Australia has advised the ATSB that they are taking the following safety actions:

Management of change

They have removed the Priority 1 Air Rescue breakaway weak-link and hi-line bag from service, introduced new replacement equipment and initiated their management of change process for their search and rescue role equipment. The performance of the operator's replacement weak-link will be monitored following the recommencement of hi-line winch evolutions.

Appointment of personnel

They have appointed an experienced search and rescue pilot into a new role of 'SAR[15] Lead'. A technical crew manager for search and rescue has also been appointed within HNZ Australia. This person is responsible for technical crew procedures, oversight and standardisation, and complement the work of the 'SAR Lead'.

Review of documentation and procedures

Two reviews of operator documentation and procedures were commenced. One was an internal review and the other a contracted external review. The results of the reviews have been presented to the operator's head of flight operations for consideration with a range of recommendations accepted and implemented.

Safety message

This serious incident highlighted the importance of change management processes and the unexpected nature of risk. The items of equipment, which comprised the hi-line (line, bag and weak-link) were individually fit-for-purpose, but when the hi-line was assembled it became susceptible to a restriction.

The International Civil Aviation Organization's safety management manual (Doc 9859) highlighted that a management of change process should take into account the criticality of systems, equipment and activities, their operational environments and past performance. The manual indicated that design factors, including equipment and task design, should be considered in the hazard identification process.

Further guidance on hazard identification and management of change for Australian operators is available from the Civil Aviation Safety Authority's Civil Aviation Advisory Publication, *CAAP SMS-1: Safety management systems for regular public transport operations*.

Detailed guidance on aviation operational risk management methodology is available from the United States Federal Aviation Administration in their system safety handbook, *Chapter 15: Operational risk management*. Hazard identification tools and examples are available in *Appendix F: ORM details and examples*.

[15] SAR: Search and rescue.

General details

Occurrence details

Date and time:	26 August 2017 – 1100 WST	
Occurrence category:	Serious incident	
Primary occurrence type:	Operational – miscellaneous - other	
Location:	Near Broome, Western Australia	
	Latitude: 17° 56.98' S	Longitude: 122° 13.67' E

Aircraft details

Manufacturer and model:	Sikorsky Aircraft S-92A	
Registration:	VH-IPE	
Operator:	HNZ Australia Pty Ltd	
Serial number:	920038	
Type of operation:	Aerial work – check and training	
Persons on board:	Crew – 5 (+1 on vessel)	Passengers – 0
Injuries:	Crew – 0	Passengers – 0
Aircraft damage:	Nil	

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.