Aviation Safety Investigation Report 199601982

Kawasaki Heavy Industries Kawasaki KH4

27 June 1996

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Aviation Safety Investigation Report

199601982

Occurrence Number: 199601982 **Occurrence Type:** Accident
Location: 8 km N Silent Grove, 175 km NE Derby
State: WA **Inv Category:** 3
Date: Thursday 27 June 1996
Time: 1030 hours **Time Zone** WST
Highest Injury Level: Fatal
Injuries:

	Fatal	Serious	Minor	None	Total
Crew	0	1	0	0	1
Ground	0	0	0	0	0
Passenger	1	2	0	0	3
Total	**1**	**3**	**0**	**0**	**4**

Aircraft Manufacturer: Kawasaki Heavy Industries
Aircraft Model: 47G3B-KH4
Aircraft Registration: VH-AHU **Serial Number:** 2166
Type of Operation: Charter Passenger
Damage to Aircraft: Substantial
Departure Point: Silent Grove WA
Departure Time: 0900 WST
Destination: Silent Grove WA

Crew Details:

Role	Class of Licence	Hours on Type	Hours Total
Pilot-In-Command	Commercial	90.0	250

Approved for Release: Thursday, March 27, 1997

FACTUAL INFORMATION

History of the occurrence

The flight was planned to take two park-rangers and a tourist on a scenic flight of the Bell and Isdell River gorges. The flight was expected to last 1 hour.

The helicopter departed Silent Grove around 0900. It flew for about 20 minutes before landing at the junction of the Isdell and Sprigg Rivers to allow the occupants to inspect a boab tree.

After 15 minutes on the ground, the helicopter departed for a further inspection of the Isdell River. About 40 minutes later, it was turned towards Silent Grove and a climb from the inspection height of 500 ft above ground level was started. As it climbed clear of the gorge, the helicopter shuddered as if affected by winds and, following a query from a passenger, the pilot advised he was looking for somewhere to land. The pilot started a descent and, as the helicopter passed 300 ft above ground level, the engine lost all power. The pilot placed the helicopter in autorotational flight before attempting a landing. He was unable to raise the nose sufficiently to complete the landing-flare and the helicopter touched down heavily on rough ground amongst large boulders.

During the landing the main rotor cut the tail boom off and the helicopter bounced and turned through 90 degrees before touching down a final time. The impact was sufficient to distort the cabin area, causing the passengers' seats to either partially or fully collapse and the pilot's seat to be torn from its mountings. Although the passengers' seat belts held them in the helicopter, the pilot was thrown out of the wreckage. The collapse of the centre rear passenger seat and the lack of shoulder restraint, allowed the occupant's upper body to be thrown forward so that it made contact with the rear of the pilot's seat.

All passengers were able to exit the wreckage and move away although all had received significant spinal injuries. One passenger untangled the pilot's legs from parts of the aircraft, but because of his injuries, he was not moved any further. The most mobile of the passengers set out on foot, shortly after the crash, to get help. He arrived at the Silent Grove campsite at around 0630 the following morning. The search for the helicopter had started on the evening of the crash as a result of information received from the wife of one of the passengers. The wreckage and survivors were not found until 1100 on the day after the crash. One passenger had died during the night from injuries received in the crash.

Pilot information

The pilot held a current commercial pilot licence with a KH4 type rating. He had limited general (250 hours) and aircraft type (90 hours) experience. Most of the pilot's KH4 experience was gained in the Silent Grove area where he conducted tourist flights.

Wreckage inspection

The wreckage was inspected at the crash site and again in Derby. No evidence was found that any aircraft system or component had failed prior to impact. An inspection of the exhaust system and spark plugs indicated that the engine had been running on a very lean fuel-air mixture at the time of the power loss. The fuel system was intact and appeared fully serviceable. There was no evidence of any leaks. The investigation team recovered 350 mL of fuel from the wreckage at the crash site. This amount was the equivalent of residual, unuseable fuel in the tanks, lines and filter.

Weight and balance

The weight and balance calculation indicated that the helicopter could only carry 74 L of fuel if its weight was to remain within the maximum limit of 1,293 kg for takeoff. The centre of gravity was calculated to be within the permitted range for takeoff at maximum weight but it was probably 5 mm forward of the forward limit during the approach for landing after the power loss. A centre of gravity forward of the forward limit can reduce the effectiveness of the cyclic control in the longitudinal plane when the helicopter is being manoeuvred in the flare for landing.

Fuel usage

The operator's operations manual indicates that fuel planning for a KH4 should be based on an average cruise fuel consumption of 70 L/h plus an allowance for a 20-minute reserve. The operator's chief pilot reported that this figure had proved accurate for most planning in AHU. It was their normal practice to allow an additional 8 L for the first start and taxi of the day.

The planned flight time of 1 hour required a minimum start-up fuel quantity of 8 L for start and taxi, 70 L for the cruise and 23 L for the reserve. The reported flight time of 60 - 70 minutes would have required 78 - 90 L not counting any reserves.

Determination of fuel quantity

The KH4 has two fuel tanks, each capable of holding 100 L of useable fuel. The tanks are interconnected and fuel can be added to either or both tanks. If fuel is added to one tank only, fuel distribution equalises rapidly. The fuel quantity in a KH4 can be determined in four ways. There is a single fuel contents gauge which indicates the quantity of fuel in the tank selected on a two-way switch (left or right tank). The fuel can be checked using a dipstick normally carried in the aircraft. The fuel level can be checked visually by looking into the tanks and comparing the level of the fuel on a tank baffle with known information. Finally, the pilot can keep a fuel log.

The pilot, who had been operating the helicopter exclusively for its last 90 flying hours, did not record any problem with the gauging system in the maintenance documentation. The chief pilot reported that he believed the system to be serviceable and accurate, although he had never operated the helicopter when fuel levels were below one-quarter. A review of the helicopter's maintenance logbooks disclosed that, due to an administrative error, an inspection of the fuel gauging system, scheduled for 12 February 1996, had not been completed by a licensed aircraft maintenance engineer.

Whilst awaiting evacuation from the crash site, the pilot commented that as the helicopter had climbed out of the Isdell River gorge on its way back to Silent Grove, the fuel gauge was indicating about one-eighth and that this should have been adequate fuel to complete the flight safely. However, a short time later and immediately before the loss of power, the gauge was indicating just above empty. An inspection and test of the fuel system following the crash indicated that the gauging system was working accurately despite the fact that the helicopter had been extensively damaged and the system had been exposed to the elements for some time prior to the test. When battery power was applied to the fuel indicating system, it functioned normally. The gauge gave accurate indications during the subsequent fuel calibration.

The pilot reported that the dip stick had fallen from the aircraft and become lost some time prior to the crash. It had not been replaced.

No evidence was found of a fuel log for the period immediately prior to the crash.

When the pilot had been employed to work from Silent Grove in the KH4 he had been briefed on the method of checking the fuel visually by the chief pilot. The pilot had made drawings indicating the expected level of fuel in the tank for different fuel quantities. The chief pilot indicated that visual determination of fuel was generally accurate. During the post-accident fuel system checks, the accuracy of this method was confirmed.

The pilot reported that he had refuelled the helicopter and checked the fuel visually prior to start up and determined there was 150 L of fuel available. This was sufficient for just under 2 hours of flying. One passenger reported that, prior to departure, the pilot had indicated to a second passenger that he was carrying sufficient fuel for 1 hour plus reserves. A third passenger reported that he assisted the pilot to add fuel to the helicopter on the morning of the accident flight. However, he did not know how much fuel was added. The passengers also reported that the pilot removed a 20-L water container prior to departure as the helicopter's weight, with pilot, passengers, fuel and other items, was near its maximum. As mentioned earlier, calculations show that the helicopter could only carry 74 L of fuel on departure (after the water container was removed) if its weight was to remain within limits. That is, the maximum allowable fuel, prior to start-up would have been 8 L for start and taxi and 74 L for the flight.

Survival aspects

As the flight was a charter flight, there was a requirement for the pilot to establish a search-and-rescue watch. For this flight, the watch could have been provided by an air traffic service agency or by the pilot leaving a flight note with a responsible person (AIP OPS FPLAN-3, paragraph 2 and 3).

An air traffic service agency search-and-rescue watch means that attempts to contact the aircraft will commence as soon as the deadline nominated by the pilot has expired. Organisation of a search, using all the facilities available, will commence 30 minutes after the deadline. A flight note will provide a similar response if the responsible person understands the reasons for the note, has a deadline to work with, knows how to raise the alarm and takes the necessary notification action promptly.

To use an air traffic service agency, the pilot needed to be able to contact it by either radio or telephone to organise the watch and then to cancel it before the deadline expired. The high frequency radio that was fitted to AHU was the usual means of establishing radio communications from the Silent Grove area with air traffic service agencies. It was unserviceable and had been sent away for repair. A telephone was not available at the Silent Grove base although contact through other agencies using a base radio was possible. One of the passengers' wives used this facility to report the helicopter missing. The pilot believed the more convenient option, under these circumstances, was to leave a flight note.

On previous charter flights the pilot had left a flight note. The pilot reported that on this occasion, a responsible person was not available at his base and as the high frequency radio was not serviceable, he decided to continue without a search-and-rescue watch.

The wife of one of the passengers became concerned when the helicopter did not return. At around 1500 she contacted the operator's office from Silent Grove and requested information on the location of AHU. It was reported that she did not appear unduly concerned at that time. The operator contacted the Perth flight service centre who, in turn, attempted to contact the helicopter. This was unsuccessful. The flight service operator also asked other aircraft to listen for signals from an emergency locator transmitter (ELT). No signals were reported. As flight service had no search-and-rescue watch responsibilities and no apprehension had been indicated, they took no further action at that stage.

The passenger's wife made contact again at around 1600. It was reported that this time she was apprehensive. The Perth flight service centre personnel were advised of the apprehension and, after attempting unsuccessfully to contact AHU, they declared an emergency and advised the search and rescue centre in Brisbane. A search was then organised.

As it was dark, the initial search concentrated on identifying an ELT signal or signal lights or fires. Although a number of aircraft flew over the crash site on the first night, no signals, lights or fires were reported. A passenger reported that they did not light a fire because of the danger of it spreading to grass around them and to the wreckage.

On the morning of the day after the crash, the walking-passenger arrived at the Silent Grove camp and was able to direct the searchers to the area of the crash site. Even so, the wreckage was not found by search aircraft until 1100. Rescue personnel were then able to treat and recover the survivors. The occupants who had remained at the crash site had no shelter from the sun and 35 degree heat. Also, they only had access to a small amount of water. This had been recovered by one of the passengers from a creek some 70 m away, in a small glass jar normally used for checking for water in the fuel.

Emergency locator transmitter

The helicopter was fitted with a fixed-installation ELT. The transmitter should have started operating automatically following the crash.

The ELT fitted to AHU could also be activated from the pilot's position by using a remote switch. After the crash the pilot directed one of the passengers to operate this switch. Although the operating light initially came on, it went out again indicating the unit may have stopped transmitting. The passengers were unable to get the light to come on again. It was found that the reset button on the remote switch panel occasionally became stuck in the pressed position. This may cause a continuous reset signal which would disable the transmitter. It could not be established if this was the situation following the crash.

Signals from the ELT were not detected until after the wreckage had been found and then only from about 2 km horizontally. The ELT in AHU was mounted on the lower fuselage in an area which was extensively damaged by the impact. The unit was torn from its bracket and was found lying on the ground under the wreckage by the rescue team. They reported that although the coaxial antenna cable was still attached to the unit, it was stretched. In addition, the line between the remote activation switch and the transmitter was disconnected and may have been severed during the crash sequence. Any signal from a damaged antenna connection could have been shielded by the wreckage lying on top of the transmitter. The fixed antenna installation was also damaged during the crash. This may have affected performance. The rescue team deactivated and removed the transmitter to prevent inadvertent operation once the wreckage had been located.

ELT reset switches

During the investigation two other examples of malfunctioning ELT reset switches were identified. The malfunction appeared to be caused by dust contamination in the press-to-operate switch.

Organisational aspects

Although the pilot lived and worked at Silent Grove the remainder of the operator's activities were based in Broome. The chief pilot reported that he maintained regular contact with the pilot by radio as well as visiting him occasionally. These contacts were to ensure the operation ran smoothly and to resolve any problems the pilot might have. The chief pilot had flown with the accident pilot in April before he started operations at Silent Grove. The check was restricted by the fact that the KH4 does not have dual-control capability. During the pilot's time at Silent Grove, the chief pilot did not develop any concerns about the operation. On the contrary, the chief pilot reported that he was satisfied with the way in which the pilot handled his various tasks.

The operator reported that the company had been sold and was due to finalise its current operations in the week following the crash. The pilot had been told this and that his job at Silent Grove would be finished once the fuel stocks were depleted, the helicopter had reached its next periodic servicing (in 10 flying hours), or on the settlement date, whichever occurred first. It was expected that one of these conditions would occur within the week.

As a result of the wind-up, the hirer had been offered flying hours to discharge credit provided by them. The credit hours were being used to introduce eco-tourism to the park rangers and tourists. The accident flight was to use one of these credit hours. The helicopter was considered to be on charter to the hirer for these flights.

ANALYSIS

The evidence indicates that the engine had lost power because all usable fuel had been consumed. The helicopter suffered a heavy landing because the pilot either misjudged the autorotational approach due to his inexperience and low initial height, or the forward position of the centre of gravity may have prevented him from raising the nose sufficiently to cushion the landing. It may also have been the result of a combination of these factors.

Fuel

As all usable fuel was exhausted after approximately 1 hour of flight and no leaks were evident, it appears that the aircraft only contained between 70 and 80 L of fuel on departure from Silent Grove. The investigation was unable to resolve the difference between the amount of fuel the pilot reported (150 L) and the amount the other evidence indicates was probably available. It is possible that the pilot made an error when he made a visual assessment of the amount of fuel in the tanks. However, this error should have become evident when the fuel gauge indications were checked.

The pilot's evidence indicates that the fuel gauge may have been providing erroneous indications. However, no evidence of this was found in the post-crash testing.

The availability of a dip stick may have improved fuel measurement, although the testing indicates that visual estimation is reasonably accurate and is unlikely to result in an error of around 70 L.

The pilot had completed a flight note for all previous flights but he did not complete one for the accident flight. This ommission deprived him of another possible check on the fuel quantity as the flight note also acts as a fuel log.

The helicopter was landed and shut down during its time away from Silent Grove. There was an opportunity to check the fuel state again then, but this was not done.

Had the aircraft contained 150 L, as reported by the pilot, aircraft weight would have exceeded the allowable maximum by approximately 54 kg at takeoff. The removal of the water container indicates the pilot had considered the aircraft's weight during his pre-departure planning.

Search-and-rescue

The decision by the pilot not to initiate a search-and-rescue watch was out of character. He had used one on all previous flights, including those which took place whilst the high frequency radio was unserviceable. The lack of a search and rescue watch delayed the start of the search.

The fitting of the ELT in an area likely to suffer significant damage in a helicopter accident, the damage to the antenna installation and the possible malfunction of the reset button, may have been factors in its lack of performance. The failure of the ELT to operate correctly also hampered the search.

Human factors

The imminent cessation of the Silent Grove operation and the use of the hirer's flight credits may have contributed to a feeling by the pilot that the flight was more for enjoyment than business. Consequently, he may have approached the flight in a less professional manner then he normally would have. This in turn may have led to a lack of adequate fuel planning and monitoring and the decision not to initiate a search-and-rescue watch.

SIGNIFICANT FACTORS

1. The pilot's employment situation and the state of the operation may have led to complacency and a lack of vigilance by him.

2. The pilot made an error in his assessment of the amount of fuel that was available for the flight, overestimating it by as much 80 L.

3. The fuel assessment error did not become apparent because the pilot did not complete a flight note including a fuel log for the trip, he did not have access to a dip stick, he did not check the fuel quantity visually at the intermediate stop, and the fuel gauge may have been giving an erroneous indication.

4. The aircraft loading was such that the centre of gravity was forward of the forward limit, thereby reducing cyclic control effectiveness.

5. As a result of fuel starvation, the pilot was forced to complete an emergency landing from low altitude and in rough terrain.

6. The lack of cyclic control effectiveness, and possibly inexperience, contributed to a heavy landing.

7. Inappropriate installation location, accident damage, and possibly a sticking reset switch, prevented proper ELT operation.

8. The pilot's decision not to initiate a search-and-rescue watch and the failure of the ELT were factors in a delay in the commencement of the search.

SAFETY ACTION

As a result of the investigation into this occurrence and other information, the Bureau of Air Safety Investigation issued Safety Advisory Notice SAN960100 to the Civil Aviation Safety Authority on 4 November 1996. The safety advisory notice highlighted the deficiencies created by the ELT switch panel and the potential for the operation and reset switches to stick due to dust ingress.

The Civil Aviation Safety Authority have since contacted the ELT manufacturer, who is in the process of reviewing the operation of the switch panel.