CANADIAN FORCES
FLIGHT SAFETY INVESTIGATION (FSI)

FINAL REPORT

FILE NUMBER: 1010-139314
DATE OF REPORT: 16 April 2003
AIRCRAFT TYPE: CH139 JET RANGER
DATE/TIME: 280417Z Jun 2002
LOCATION: Southport, MB
CATEGORY: "B" CATEGORY ACCIDENT

SYNOPSIS

The instructor and student were conducting a Night 1 Lesson Plan. Following some initial circuit work in Area North they proceeded to 'Grabber Green' autorotation landing area. The instructor was demonstrating a '500 foot' straight ahead autorotation to touchdown. He terminated the autorotative flare higher than normal and could not reduce the subsequent rate of descent prior to ground impact. The crew received minor back strain injuries. The aircraft sustained "B" category damage.

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1 FACTUAL INFORMATION

GENERAL

The instructor and student were conducting a Night 1 Lesson Plan. This trip is the student's first exposure to flying a rotary wing aircraft at night. The purpose of the flight is to introduce the student to aircraft handling considerations for night flight.

1.1 History of the Flight

The crew commenced the lesson plan with circuit work to a 'field lighting' landing zone ('Y' pattern lights) and after several circuits proceeded to 'Grabber Green' to demonstrate and practice autorotations. The instructor began the exercise by setting up for a long final approach and completed the required pre-entry check. When the landing light was switched on during the post entry check, a thin layer of mist illuminated by the light momentarily distracted the instructor. He stated that this was only of short duration and did not affect the remainder of the manoeuvre. After completing the descent check (100 foot check), an aggressive collective check (flare termination) resulted in a higher than normal level off altitude and low rotor RPM (RRPM). The instructor commenced a 'low level save' (application of throttle and collective power), but the aircraft hit the ground firmly before the RRPM recovered. The helicopter bounced, rotated 40 degrees to the right and landed approximately one aircraft length from the initial touchdown point. The crew reported hearing considerable noise from the transmission area. Suspecting that the gearbox had exceeded its movement parameters, the instructor shut down the aircraft in accordance with school orders and reported the hard landing to the fire hall. The aircraft was secured and the crew transported to the local hospital for medical examination.

1.2 The Instructor

The instructor had not flown night autorotations to touchdown for 6 months. This was either due to a lack of sufficient wind on those evenings that the night autos trips had been scheduled or because he was not teaching a student that was in the night phase of the course. In anticipation of the scheduled night phase for the current course, the instructor completed a check ride with one of the school standards officers (19 Jun 02) to regain currency in night autos to touchdown. School Orders require instructors to complete an autorotation to touchdown within 48 hours prior to conducting night autorotations. The instructor fulfilled this requirement earlier on the occurrence day. The instructor was qualified and current for the mission parameters.

1.3 Injuries to Personnel

	Crew
Fatalities	0
Major injury	0
Minor injury	2

1.4 Damage to Aircraft

The skid gear was slightly splayed. The tail boom flexed in both directions of the vertical plane causing buckling (Photo 1 and 2). The spike box on the underside of the transmission was sheared and both pitch horns were gouged from contact with the aft transmission housing. The aircraft was sent to third line contractor to repair the tail boom. Damage was assessed as 'B' CAT.

1.5 Collateral Damage

Nil

1.6 Personnel Information

	Instructor Pilot	**Student Pilot**
Rank	Capt.	2 Lt
Currency	Current B Cat Instructor	Under training
Medical Category valid	Yes	Yes
Total flying time	2350	177
Flying hours on type	522	43
Flying hours last 30 days	42	24.5
Flying hours last 48 hours	3.9	3.9
Flying hours on day of Occurrence	1.0	2.8

1.7 Aircraft Information

The aircraft was fully serviceable prior to the occurrence.

1.8 Meteorological Information

TAF: 28006 20008KT P6SM FEW250 BECMG 0204 15005KT

Actual 0415Z: CLR 15SM Temp 22/18 Wind 200/7 ALT 29.81

Density Altitude: 2320 feet

1.9 Aid to Navigation

Not Applicable.

1.10 Communications

The fire hall has one truck and response crew stationed at ‘Grabber Green’ while the helicopter school is conducting autorotation training. The instructor reported the hard landing to the firefighters and they responded within one minute. The firefighters called the Southport Tower to initiate the ‘one bell’ response.

1.11 Aerodrome/Alighting Area Information

‘Grabber Green’ is a 500 x 500 meter grass field located 8 kilometers east of the Southport airport. It is has a windsock and fire response. For night autorotations, there is a laneway of lights placed on the strip to provide visual references for landing.

1.12 Flight Recorders

The Jet Ranger aircraft in Southport are not equipped with any onboard recording devices. The determination of what the aircraft was doing in the last minute of flight was made more difficult and was established with less certainty by the lack of such devices.

1.13 Wreckage and Impact Information

The aircraft initially struck the ground while on a heading of 180 degrees magnetic. It landed approximately half way down the lighted laneway on short grass. The aircraft bounced, rotated 40 degrees to the right and landed approximately one aircraft length from the initial touchdown point on a heading of 222 degrees. There were no impact marks on the surface of the landing area and no wreckage scattered from the aircraft.

1.14 Medical

A Jet Ranger helicopter transported the two pilots from ‘Grabber Green’ to the Southport ramp. A civilian ambulance was used to transport the crew to the Portage hospital, where a civilian doctor (not a Flight Surgeon) treated them. The crew were examined for minor back strain and released. A follow up exam was conducted by the Flight Surgeon the next day. The hospital staff took toxicology samples from the crew. The student pilot tested positive for a common over-the-counter cold medicine. He was subsequently counselled by the flight surgeon on the hazards of self-medication.

1.15 Fire, Explosive Devices, and Munitions

Nil

1.16 Survival Aspects

1.16.1 Crash Survivability

This was a survivable occurrence. Both sets of restraints held the pilots in position. There was no significant contact between the pilots' heads or limbs and the internal structures of the aircraft. The pilots were wearing approved Aircrew Life Support Equipment (ALSE), including helmet, gloves, boots and flight suits.

1.16.2 Emergency Transmitters

The impact forces were not sufficiently strong to activate the ELT.

1.16.3 Search and Rescue

Not applicable.

1.17 Test and Research Activities

Nil

1.18 Additional Information

Nil

2 ANALYSIS

2.1 General

Aircraft serviceablility and weather were not contributory factors to the accident. The investigation therefore concentrated on the actions of the instructor.

2.2 The Night Autorotation

Night Lesson Plan 1 is the ab-initio pilot's first exposure to the unique aspects of helicopter flying in the dark. As part of this introduction, the instructor demonstrates and the student flies an autorotation to touchdown. The visual clues to judge height above ground, drift and closure rate to the ground are degraded due to darkness. To compensate for this, the manoeuvre is flown to a lighted laneway and crews utilise the aircraft landing light to more accurately gauge height above ground.

The sequence is flown in the same manner as the day auto. The aircraft is positioned a suitable distance from the landing area at 500 feet above ground and 90 knots. The throttle is retarded to idle, the collective lowered to flat pitch to conserve rotor RPM (RRPM) and the aircraft attitude adjusted to achieve a 60 knot glide. At 75 feet above ground a flare is initiated to reduce the rate of descent and forward speed. When the flare is no longer effective (tail stinger 4-6 feet above ground, cockpit height 10 feet above ground) a collective check is initiated, the aircraft levelled and cushioned onto the ground using the remaining rotor energy. Post entry and pre-landing checks (100 foot check) are conducted to ensure flare entry parameters that will maximize opportunity for a safe flare and landing.

2.3 Performance Variables

With the engine at idle, any collective pitch increase will bleed off RRPM due to increased drag. When the RRPM gets too low it will no longer provide lift. It takes considerable skill and practice to consistently judge the timing of collective application - too early and the rotor will run out of lift before the aircraft is safely on the ground; too late and the aircraft will hit the ground with insufficient cushioning to prevent damage. The amount of headwind will affect the degree of flare required. The greater the headwind the less flare required due to the deceleration forces of the wind. In light winds the flare must be more aggressive (steeper) to achieve the same deceleration effect. Density altitude (DA) also

affects the performance of an aircraft during autorotation. The air is less dense with higher DA values. Therefore, the higher the DA, the less effective is the lifting surface (rotor). In high DA conditions the flare must also be more aggressive to achieve the same deceleration effect present during low DA days.

2.4 The Accident

The crew proceeded to the autorotative landing strip following a warm up period of circuit training. The instructor was flying the first approach to demonstrate the 'straight ahead' auto from 500 feet. Although he had flown an auto trip earlier in the day, this was his first night auto to touchdown during the mission. Wind conditions were ideal with a southerly flow of 10 knots. The ground elevation at Southport is 885 feet, but due to temperature and humidity, the DA was high (2300 feet). The entry and descent went normally with post entry and pre-landing checks completed as required. The instructor stated that there was a thin mist layer at the level of flare initiation, but this was only a momentary distraction and did not affect the rest of the manoeuvre. The flare entry progressed normally but the instructor elected to terminate the flare with a more aggressive collective check due to the high DA. Either the collective check was too aggressive for the conditions or the timing was too early because the aircraft ended up being too high for the level-off and cushion stage (~10 feet). The instructor stated that the rotor RPM (RRPM) was quite low at this point. As mentioned above, as soon as collective pitch is applied, the RRPM begins to bleed off. From the normal 4-6 foot 'level-off the aircraft can still be cushioned before the rotor energy is depleted. From 10 feet with low RRPM it becomes more difficult to safely land the aircraft. The instructor recognised his error and attempted to overshoot by adding throttle ('low level save'). Throttle application was tentative as the instructor was concerned about causing a loss of tail rotor effectiveness. If the RRPM gets low (70% range) the tail rotor speed and effectiveness become proportionally lower as well. If throttle is applied too quickly, high torque levels can be reached prior to the tail rotor reaching sufficient effectiveness to counter the main rotor torque. This can cause a loss of tail rotor effectiveness and result in an uncontrolled swing of the aircraft tail. If this were to happen as the aircraft was touching down it could cause the helicopter to roll over. It is therefore difficult to determine if a more positive application of throttle would have prevented the accident or simply aggravated the situation. Regardless, there was insufficient rotor RPM left at the cushion stage to safely land the aircraft.

2.5 Peripheral Issues

Instructor proficiency in night flying is not re-evaluated following completion of the Flight Instructor Course. This means that instructor ability to safely execute a night autorotation, conduct circuit training and basic aircraft handling at night is not re-visited unless a lapse in currency takes place. This was not a factor in this accident as the instructor had recently regained currency in night autorotations

during a standards check ride. However, it would seem prudent that night proficiency be included in the annual category check for instructors.

At the time of the accident, students were still being assessed for their ability to execute night autos despite the removal of night solo flights from the training syllabus. In order to reduce the risk exposure incurred during night autos, the school has since removed the night auto as an assessed manoeuvre for students.

3 CONCLUSIONS

3.1 Findings

3.1.1 The instructor was qualified and current for the mission.

3.1.2 The aircraft was serviceable prior to the occurrence.

3.1.3 The instructor utilised an aggressive flare termination (collective check) to compensate for the high density altitude.

3.1.4 At the point of flare termination, the aircraft was higher than normal with low rotor RPM. This created a dangerous rate of descent.

3.1.5 The instructor initiated a power recovery, but due to the tentative application of throttle to avoid loss of tail rotor effectiveness, was unable to reduce the rate of descent to a safe level prior to ground contact.

3.1.6 The helicopter students at 3 CFFTS no longer fly night solo missions.

3.1.7 Instructor proficiency in night flying (including autorotations) is not checked subsequent to the Flight Instructor Course.

3.2 Causes

3.2.1 The instructor mis-judged the termination of the autorotative flare and due to the gradual application of throttle in the ‘low level save’, he was unable to safely reduce the rate of descent prior to ground impact.

4 SAFETY ACTION

4.1 Safety Action Taken

4.1.1 To reduce the risk exposure incurred during night autos, 3 CFFTS has removed the night auto as an assessed manoeuvre for students. The school continues to demonstrate the ‘500 foot’ straight ahead and turning autos to expose the students to the unique aspects of night autorotations.

4.1.2 3 CFFTS has implemented further safety restrictions for night autos to include no obscuring phenomena and a maximum density altitude of 3000 feet.

4.1.3 3 CFFTS has added two night missions to the Flight Instructors Course in order to allow further proficiency training in night autorotations.

4.2 Safety Action Recommended

It is recommended that:

4.2.1 instructor proficiency in night flying skills be assessed on a regular basis.

4.2.2 3 CFFTS place more emphasis on training and assessing instructors in the ‘low level save’ technique for both night and day autorotations.

4.3 DFS Comments

The air force no longer operates single engine helicopters in the line squadrons and therefore the risk of power loss due to engine failure alone is remote. Nevertheless, the recent Griffon accident tragically reminded us that non engine failure emergencies also require autorotation, and the possibility of shutting down the wrong engine after a single engine emergency has not been completely engineered out. The ability to conduct an autorotation remains a necessary skill for helicopter pilots and we must ensure that our pilots receive the training required to successfully execute this emergency procedure. Sufficient training to ensure crews have the skills to preserve life and limb is a moral obligation. Sufficient training to optimize their chances of landing the aircraft successfully must be traded off with the risk of damage or injury caused by practicing the manoeuvre.

Autorotation training continues to be a risk management exercise. Over the years safety buffers have been developed to mitigate the risk and maximize the training value. Night autos have an added dimension of risk due to the reduction in visual cues. The additional safety measures indicated in paragraph 4.1 will provide a measure of risk mitigation. The implementation of the recommendations in paragraph 4.2 will provide a further margin of risk mitigation.

R.E.K. Harder
Colonel
Director of Flight Safety

Annex A – Photographs

Photo 1: Tail boom – starboard side buckling
Poutre de queue – gauchissement côté droit

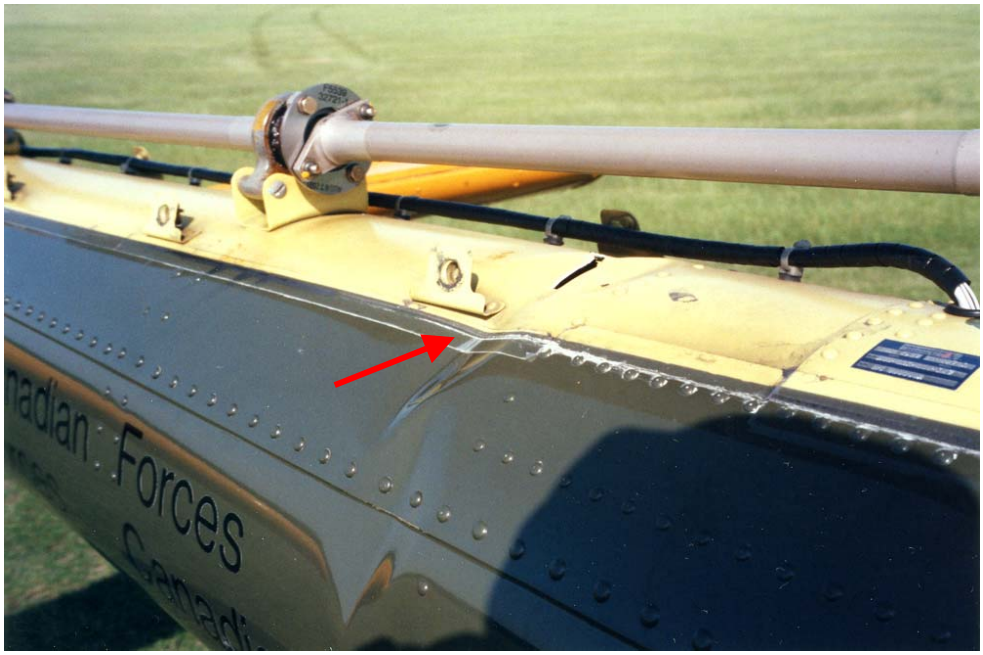

Photo 2: Tail boom – looking aft
Poutre de queue – vue vers l'arrière