Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A09O0207

COLLISION WITH TERRAIN

ROBINSON R22 ALPHA (HELICOPTER) N97CP
HUTTONVILLE, ONTARIO
21 SEPTEMBER 2009

Canada

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

Aviation Investigation Report

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Report Number A09O0207

Summary

The Robinson R22 Alpha helicopter (registration N97CP, serial number 0421) departed Toronto City Centre Airport, Ontario, on a short flight to the pilot's private helipad in the rural town of Norval, Ontario. At 2000 Eastern Daylight Time, in the hours of darkness, the helicopter crashed 1.8 nautical miles northeast of the final destination. The helicopter erupted into flames at impact and was partially consumed by a post-crash fire. The pilot was fatally injured.

Ce rapport est également disponible en français.

Other Factual Information

History of Flight

On the evening of the occurrence, the helicopter departed Toronto City Centre Airport (CYTZ), Ontario, at 1942, [1] for a 20-minute visual flight rules (VFR) flight to the owner/pilot's residence. The pilot routinely flew this route. Recorded air traffic control radar data indicate that the helicopter departed toward the west and initially climbed to approximately 1300 feet above sea level (asl) and continued along the lake shore of Lake Ontario. It then climbed to 1500 to 1600 feet asl, approximately 1000 feet above ground level (agl), turned right and continued in a northwesterly direction toward its intended destination.

At 1958:51, the helicopter started a right turn, which was followed by a tight left climbing turn. The helicopter reached a maximum altitude of 1800 feet asl (1150 feet agl) at 1959:15 and then began to descend rapidly while continuing the left turn. Radar data ends at 1959:29, when the helicopter was at 1300 feet asl (650 feet agl).

Moments before the crash, the helicopter was heading in an easterly direction then abruptly pitched nose down and crashed into the treed swampy area one nautical mile (nm) south of Huttonville, Ontario, a small rural community within the city of Brampton, Ontario.

Helicopter Information

The Robinson R22 Alpha is a two-seat helicopter manufactured by the Robinson Helicopter Company and was certified for VFR operations only. N97CP was manufactured in 1984. The pilot had purchased and registered the helicopter in the United States in February 2009. The pilot then brought the helicopter into Canada and, although required by regulations, it had not been registered in Canada. It was insured in the United States in February 2009; however, that policy was cancelled in March 2009 by the insurer when it discovered that the helicopter was no longer based in the United States. While paragraph 606.02(8)(a) of the *Canadian Aviation Regulations* prohibits an aircraft owner to operate an aircraft without liability insurance, insurance was never obtained following the cancellation of the original policy.

Records indicate that the helicopter was equipped and maintained in accordance with existing United States *Federal Aviation Regulations* (FARs) and approved procedures. The helicopter's journey logbook was not located. Technical logbook records indicate that an annual inspection had been completed on 22 May 2009, in the United States. At that time, it had a total airframe time of 3555 hours and 1115 hours since the last overhaul. Nothing unusual was found during the inspection.

The helicopter was operated using 91 octane automotive gasoline (MOGAS). According to the aircraft type certificate, this was not a fuel approved for use in the helicopter. Supplemental type certificate (STC) SH760NE allows the use of MOGAS. There are no records at the United States Federal Aviation Administration (FAA) indicating that the STC was installed on the

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[1] All times are Eastern Daylight Time (Coordinated Universal Time minus four hours).

accident helicopter; however, aircraft records indicate that the STC was installed on 08 August 2003 and that the appropriate placards were in place indicating that the helicopter could be fuelled with MOGAS.

The helicopter was used regularly by the pilot to commute between his residence located in Norval and Toronto in the previous eight months. The number of hours flown in that period was approximately 100 hours with most flights being approximately 20 minutes in duration.

The helicopter had no known deficiencies before the flight and was being operated within its load and centre of gravity limits. The aircraft was not equipped with on-board recorders and these were not required by regulation.

Pilot Information

The pilot held a valid United States private pilot licence issued on 08 December 2008, with the rotorcraft-helicopter rating valid for day and night VFR flight. Records indicate that the pilot was certified and qualified for the flight in accordance with existing FARs. He had accumulated approximately 210 hours of total flying time, including 110 hours as pilot in command. All flying was done on Robinson R22 helicopters.

There was no indication of any physiological issues that might have contributed to the accident.

Weather

There is no official weather reporting station in Huttonville. Sunset was at 1918, the end of civil twilight at 1947, and the moon had not risen. Due to the overcast sky and limited ground lighting, the area was in total darkness. At 2000, the time of the occurrence, the aviation routine weather report for Toronto/Lester B. Pearson International Airport (CYYZ), located 8 nm east of Huttonville, was as follows: wind 130° true (T) at 4 knots, visibility 5 statute miles, mist, scattered clouds at 3800 feet agl, overcast clouds at 8500 feet agl, temperature 19°C, dew point 18°C, altimeter setting 30.11 inches of mercury.

Wreckage Examination

The crash site was located in a swampy clearing surrounded by a mixture of mature deciduous and coniferous trees ranging in height from 30 to 70 feet. The helicopter struck some of the upper branches of the taller trees during descent, consistent with a 50° descent angle. The helicopter struck the ground in an estimated 50° nose-down attitude and came to rest approximately nine feet from the initial impact point. The helicopter was substantially damaged during the impact and post-crash fire, which partially destroyed the front of the helicopter.

There were no signs of any pre-impact mechanical failure or system malfunction that could have contributed to this accident. Examination of the engine and drivetrain indicates that they were not turning at impact. Furthermore, examination of the low rotor revolutions per minute (rpm) warning lamp showed signs of stretch in the filament consistent with the lamp being illuminated at the time of impact. There was no evidence of rotor mast bumping, excessive blade coning, or main rotor blade contact with the tail boom.

The fuel mixture and carburetor heat controls are located on the centre pedestal in close proximity to each other. To aid in identification, the control knobs are shaped differently. Furthermore, the fuel mixture control knob is red while the carburetor heat control knob is black (see Photo 1). To prevent the inadvertent deployment in flight, the manufacturer's checklist directs the pilot to place a removable cylindrical plastic guard over the mixture control knob before starting the engine (see Photo 2). This guard is not to be removed until engine shutdown when the mixture control knob is pulled to the idle cut-off position (see Photo 3). This plastic guard is not permanently attached to the control panel. While the plastic guard was found at the crash site, it could not be determined whether it was used at the time of the occurrence.

Photo 1. Centre pedestal with mixture control at upper right and carburetor heat control at lower right

Photo 2. Mixture control pushed in to full rich with guard installed

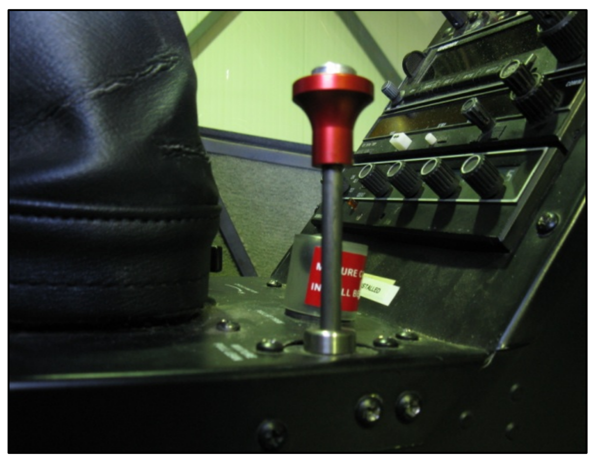

Photo 3. Mixture control pulled out to idle cut-off with guard removed

The engine and fuel controls were found as follows:

- The mixture control knob was pulled out and bent back. The mixture control is a push/pull control with a push button locking feature and therefore most likely did not move at impact.

- The carburetor heat control knob was fully in (cold). The carburetor heat control is a standard push/pull control with no locking feature and may have moved at impact.

- The throttle position (connecting rod) was found in the full open position.
- The fuel selector located on the rear cabin bulkhead above and behind the left passenger seat was found in the OFF position. This likely moved to the OFF position during impact.
- The mixture arm position on the carburetor was full rich and the carburetor heat slider was partially open. Both of these likely moved during impact.

The pilot was flying from the right seat and was ejected at impact. The pilot was found approximately 26 feet from the initial impact point. The pilot's lap belt buckle was found secured. The lap belt attachments were torn out of the airframe at impact and the lap belt was found on the ground between the pilot and the wreckage. A helmet was found at the scene, but the pilot was not wearing it at the time of the occurrence.

Robinson Helicopter Company Safety Notices

Following previous accidents and incidents, the Robinson Helicopter Company had taken safety actions, issuing several safety notices (SN) to its operators to reduce the likelihood of recurrence. These are published on its website and at the back of the pilot's operating handbook (POH). Of particular relevance are the following SNs, all of which document issues that may have contributed to this accident (see Appendix A to Appendix G – Safety Notices):

1. SN-1 – Inadvertent Actuation of Mixture Control in Flight
2. SN-10 – Fatal Accidents Caused by Low RPM Rotor Stall
3. SN-18 – Loss of Visibility Can Be Fatal and Overconfidence Prevails in Accidents
4. SN-24 – Low RPM Rotor Stall can be Fatal
5. SN-25 – Carburetor Ice
6. SN-26 – Night Flight Plus Bad Weather Can Be Deadly
7. SN-31 – Governor Can Mask Carb Ice

Emergency Procedures

The POH prescribes the following emergency procedure for a power failure above 500 feet:

1. Lower collective immediately to maintain RPM and enter normal autorotation.
2. Establish a steady glide at approximately 65 KIAS.
3. Adjust collective to keep RPM in green arc or apply full down collective if light weight prevents attaining above 97%.
4. Select landing spot and, if altitude permits, manoeuvre so landing will be into wind.
5. A restart may be attempted at pilot's discretion if sufficient time is available.
6. If unable to restart, turn off unnecessary switches and shut off fuel.
7. At about 40 feet agl, begin cyclic flare to reduce rate of descent and forward speed.

8. At about 8 feet agl, apply forward cyclic to level ship and raise collective just before touchdown to cushion landing. Touchdown in level attitude with nose straight ahead.

Carburetor Icing

Carburetor icing is a phenomenon where water vapour in the air freezes as it passes through the carburetor. When the throttle is open and the relative humidity is high, ice can form in the venturi, restricting air flow. Unchecked, this could result in either a reduction or a complete loss of power. If enough ice forms, the venturi throat can be completely blocked, causing total engine failure. When the throttle valve is closed to lower the power during a descent, ice will form at the edge of the throttle valve in the area of reduced pressure and fuel vaporization. To overcome carburetor icing, the airframe manufacturer provided a system to heat the incoming air and to prevent water condensation.

To help determine whether a flight is more or less susceptible to carburetor ice, charts based on knowledge of dry (ambient) air and wet (dew point) air temperatures have been produced. Depending on the level of severity, pilots would make use of carburetor heat more or less often to prevent ice from accumulating. These charts, however, are based on the use of aviation grades of fuel and may not apply to aircraft using MOGAS. MOGAS is more likely to cause carburetor ice because of its lower vapour point.

Unlike aeroplanes, which take off at wide open throttle, helicopters take off using only power as required, making them vulnerable to carburetor ice, especially when the engine and induction system are still cold. The Robinson R22 governor can easily mask carburetor icing by automatically increasing the throttle to maintain engine rpm, which will also result in a constant manifold pressure. Robinson Helicopter Company recommends the following:

1. During takeoff, use full carburetor heat during warm-up to preheat the induction system and then apply carburetor heat as required during hover and takeoff to keep the Carburetor Air Temperature (CAT) gauge out of the yellow arc.
2. During climb or cruise, apply carburetor heat as required to keep CAT gauge out the yellow arc.
3. During descent or autorotation, below 18 inches manifold pressure, ignore the CAT gauge and apply full carburetor heat.

At the time of the occurrence, the meteorological conditions were conducive to moderate carburetor icing during cruise and descent on aircraft using aviation grade 100 low lead fuel.

Spatial Disorientation

All humans are susceptible to spatial disorientation. In aviation, spatial disorientation can be defined as the failure of aviators to sense correctly the position, motion, or attitude of their aircraft or themselves with respect to the earth's surface and gravity.

According to FAA documentation, [2] spatial orientation defines our natural ability to maintain our body orientation and/or posture in relation to the surrounding environment (physical space) at rest and during motion. Humans generally maintain spatial orientation on the ground. The three-dimensional environment of flight is unfamiliar to the human body, creating sensory conflicts and illusions that make spatial orientation difficult, and sometimes impossible to achieve. Statistics show that, between 5 and 10 per cent of all general aviation accidents can be attributed to spatial disorientation, 90 per cent of which are fatal.

Analysis

The sole occupant of the helicopter was fatally injured in the accident. There were no witnesses to the final moments of the flight and there were no on-board recording devices to assist investigators. Examination of the helicopter engine indicates that it was not running at impact and that the helicopter struck the ground in a 50-degree nose-down attitude suggesting an in-flight loss of control. Although the helicopter was extensively damaged, there were no signs of any pre-impact mechanical failure or system malfunction that could have contributed to this accident. As a result, this analysis focuses on possible scenarios for what caused the engine to stop running and why the helicopter departed controlled flight and collided with terrain.

While it was not possible to determine accurately the position of the carburetor heat control before impact, the mixture control knob was found out and bent. With the push button locking feature, it is unlikely that the mixture control moved during the impact. It was, therefore, likely in the idle cut-off position at impact.

Two scenarios were considered why the pilot inadvertently pulled the mixture control to the idle cut-off position, causing the engine to shut down:

- On approaching destination and in preparation for descent, the pilot attempted to apply carburetor heat.
- The meteorological conditions were conducive to moderate carburetor icing during cruise and descent. The Robinson R22 governor can easily mask carburetor icing by automatically increasing the throttle to maintain engine rpm, which will also result in a constant manifold pressure. It is possible that the helicopter’s engine developed carburetor ice en route, causing performance degradation or a total power loss. To correct this situation, the pilot would have attempted to apply carburetor heat.

The mixture control knob is shaped differently than the carburetor heat knob. To reposition the mixture control, the pilot needs to action the push button locking feature. In addition, to prevent its inadvertent actuation, the manufacturer also requires that a cylindrical plastic guard be placed over the mixture control knob, from the time the engine is started until such time as the engine is shut down. This plastic guard would make it difficult to inadvertently action the mixture control and would also provide tactile feedback that the pilot was attempting to move

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[2] Federal Aviation Administration, *Medical Facts for Pilots*, publication AM-400-03/1

the wrong control knob. In order for the pilot to be able to pull the mixture control knob to the idle-cut off position, it is likely that the plastic guard had not been placed over the mixture control knob as required.

In the Robinson R22, the pilot must take immediate action following a loss of power to ensure that rotor rpm is maintained. Failure to do this can lead to a low rotor rpm and rotor stall from which recovery may not be possible. The Robinson R22 POH emergency procedures for a power loss above 500 feet in part instructs the pilot to immediately lower the collective to maintain rotor rpm and enter a normal autorotation. A restart may be attempted at the pilot's discretion if sufficient time is available. If unable to restart, the pilot should turn off unnecessary switches and shut off the fuel.

Approximately 40 seconds before the crash, the helicopter started to turn to the right, then immediately started turning sharply to the left and climbed 300 feet. Approximately 20 seconds before the crash, the helicopter began a rapid descent from 1800 feet asl to the crash site at 650 feet asl; this equates to a descent rate of approximately 3450 feet per minute. According to Robinson Helicopter Company Safety Notices SN-18 and SN-26, helicopters have less inherent stability and much faster roll rates than aeroplanes. Loss of the pilot's outside visual references, even for a moment, can result in spatial disorientation, wrong control inputs and an uncontrolled crash.

With a lack of visual reference at night, limited visibility due to weather and the pilot's relative inexperience, the pilot likely became spatially disoriented while dealing with the power loss emergency. Unable to determine the correct attitude of the helicopter without visual reference, the pilot lost control, resulting in uncontrolled flight into the terrain.

The following TSB Laboratory reports were completed:

LP 144/2009 – Instrument Examination
LP 145/2009 - Radar Data Analysis

These reports are available from the Transportation Safety Board of Canada upon request.

Findings as to Causes and Contributing Factors

1. It is likely that, while attempting to apply carburetor heat, the pilot inadvertently pulled the mixture control knob to the idle cut-off position, causing the engine to shut down.

2. It is likely that the plastic guard had not been placed over the mixture control knob, resulting in the pilot being able to pull the control to the cut-off position.

3. Following the engine shutdown, the rotor rpm was allowed to decay, resulting in a loss of control and uncontrolled flight into the terrain.

4. With few visual references, the pilot likely became spatially disoriented, contributing to the inability to maintain control.

Other Findings

1. The helicopter was being operated in Canada without liability insurance, as required by *Canadian Aviation Regulations* (CARs).

2. The helicopter had not been registered in Canada as required by CARs.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 18 May 2010.

*Visit the Transportation Safety Board's Web site (*www.bst-tsb.gc.ca*) for information about the Transportation Safety Board and its products and services. There you will also find links to other safety organizations and related sites.*

Appendix A – Safety Notice SN-1

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Safety Notice SN-1

Issued: Jan 81 Rev: Feb 89; Jun 94

INADVERTENT ACTUATION OF MIXTURE CONTROL IN FLIGHT

Cases have been reported where a pilot inadvertently pulled the mixture control instead of the carb heat or other control, resulting in sudden and complete engine stoppage. The knobs are shaped differently and the mixture control has a guard which must be removed and a push-button lock which must be depressed before actuating. These differences should be stressed when checking out new pilots. Also, in the R22, it is a good practice to always reach around the left side of the cyclic control when actuating the lateral trim. This will lessen the chance of pulling the mixture control by mistake. Always use the small plastic guard which is placed on the mixture control prior to starting the engine and is not removed until the end of the flight when the idle cut-off is pulled. Replace the guard on the mixture control so it will be in place for the next flight.

If the mixture control is inadvertently pulled, lower the collective and enter autorotation. If there is sufficient altitude, push the mixture control in and restart the engine using the left hand. DO NOT disengage the clutch.

Appendix B – Safety Notice SN-10

ROBINSON
HELICOPTER COMPANY

Safety Notice SN-10

Issued: Oct 82   Rev: Feb 89; Jun 94

<u>FATAL ACCIDENTS CAUSED BY LOW RPM ROTOR STALL</u>

A primary cause of fatal accidents in light helicopters is failure to maintain rotor RPM. To avoid this, every pilot must have his reflexes conditioned so he will instantly add throttle and lower collective to maintain RPM in any emergency.

The R22 and R44 have demonstrated excellent crashworthiness as long as the pilot flies the aircraft all the way to the ground and executes a flare at the bottom to reduce his airspeed and rate of descent. Even when going down into rough terrain, trees, wires or water, he must force himself to lower the collective to maintain RPM until just before impact. The ship may roll over and be severely damaged, but the occupants have an excellent chance of walking away from it without injury.

Power available from the engine is directly proportional to RPM. If the RPM drops 10%, there is 10% less power. With less power, the helicopter will start to settle, and if the collective is raised to stop it from settling, the RPM will be pulled down even lower, causing the ship to settle even faster. If the pilot not only fails to lower collective, but instead pulls up on the collective to keep the ship from going down, the rotor will stall almost immediately. When it stalls, the blades will either "blow back" and cut off the tailcone or it will just stop flying, allowing the helicopter to fall at an extreme rate. In either case, the resulting crash is likely to be fatal.

No matter what causes the low rotor RPM, the pilot must first roll on throttle and lower the collective simultaneously to recover RPM **<u>before</u>** investigating the problem. It must be a conditioned reflex. In forward flight, applying aft cyclic to bleed off airspeed will also help recover lost RPM.

Appendix C – Safety Notice SN-18

ROBINSON
HELICOPTER COMPANY

Safety Notice SN-18

Issued: Jan 85 Rev: Feb 89; Jun 94

LOSS OF VISIBILITY CAN BE FATAL

Flying a helicopter in obscured visibility due to fog, snow, low ceiling, or even a dark night can be fatal. Helicopters have less inherent stability and much faster roll and pitch rates than airplanes. Loss of the pilot's outside visual references, even for a moment, can result in disorientation, wrong control inputs, and an uncontrolled crash. This type of situation is likely to occur when a pilot attempts to fly through a partially obscured area and realizes too late that he is losing visibility. He loses control of the helicopter when he attempts a turn to regain visibility but is unable to complete the turn without visual references.

You must take corrective action before visibility is lost! Remember, unlike the airplane, the unique capability of the helicopter allows you to land and use alternate transportation during bad weather, provided you have the good judgement and necessary willpower to make the correct decision.

OVERCONFIDENCE PREVAILS IN ACCIDENTS

A personal trait most often found in pilots having serious accidents is overconfidence. High-time fixed-wing pilots transitioning into helicopters and private owners are particularly susceptible. Airplane pilots feel confident and relaxed in the air, but have not yet developed the control feel, coordination, and sensitivity demanded by a helicopter. Private owners are their own boss and can fly without discipline, enforced rules, or periodic flight checks and critique by a chief pilot. A private owner must depend on self-discipline, which is sometimes forgotten.

When flown properly and conservatively, helicopters are potentially the safest aircraft built. But helicopters are also probably the least forgiving. They must always be flown defensively. The pilot should allow himself a greater safety margin than he thinks will be necessary, just in case.

Appendix D – Safety Notice SN-24

ROBINSON
HELICOPTER COMPANY

Safety Notice SN-24

Issued: Sep 86 Rev: Jun 94

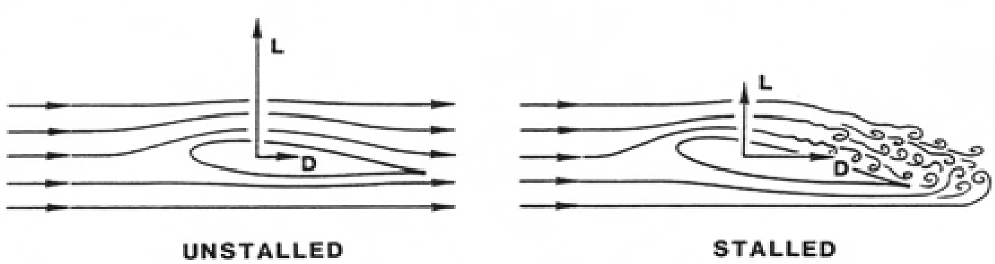
LOW RPM ROTOR STALL CAN BE FATAL

Rotor stall due to low RPM causes a very high percentage of helicopter accidents, both fatal and non-fatal. Frequently misunderstood, rotor stall is not to be confused with retreating tip stall which occurs only at high forward speeds when stall occurs over a small portion of the retreating blade tip. Retreating tip stall causes vibration and control problems, but the rotor is still very capable of providing sufficient lift to support the weight of the helicopter.

Rotor stall, on the other hand, can occur at any airspeed and when it does, the rotor stops producing the lift required to support the helicopter and the aircraft literally falls out of the sky. Fortunately, rotor stall accidents most often occur close to the ground during takeoff or landing and the helicopter falls only four or five feet. The helicopter is wrecked but the occupants survive. However, rotor stall also occurs at higher altitudes and when it happens at heights above 40 or 50 feet AGL it is most likely to be fatal.

Rotor stall is very similar to the stall of an airplane wing at low airspeeds. As the airspeed of an airplane gets lower, the nose-up angle, or angle-of-attack, of the wing must be higher for the wing to produce the lift required to support the weight of the airplane. At a critical angle (about 15 degrees), the airflow over the wing will separate and stall, causing a sudden loss of lift and a very large increase in drag. The airplane pilot recovers by lowering the nose of the airplane to reduce the wing angle-of-attack below stall and adds power to recover the lost airspeed.

The same thing happens during rotor stall with a helicopter except it occurs due to low rotor RPM instead of low airspeed. As the RPM of the rotor gets lower, the angle-of-attack of the rotor blades must be higher to generate the lift required to support the weight of the helicopter. Even if the collective is not raised by the pilot to provide the higher blade angle, the helicopter will start to descend untii the



Wing or rotor blade unstalled and stalled.

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Appendix D –Safety Notice SN-24 (continued)

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Safety Notice SN-24 (continued)

upward movement of air to the rotor provides the necessary increase in blade angle-of-attack. As with the airplane wing, the blade airfoil will stall at a critical angle, resulting in a sudden loss of lift and a large increase in drag. The increased drag on the blades acts like a huge rotor brake causing the rotor RPM to rapidly decrease, further increasing the rotor stall. As the helicopter begins to fall, the upward rushing air continues to increase the angle-of-attack on the slowly rotating blades, making recovery virtually impossible, even with full down collective.

When the rotor stalls, it does not do so symmetrically because any forward airspeed of the helicopter will produce a higher airflow on the advancing blade than on the retreating blade. This causes the retreating blade to stall first, allowing it to dive as it goes aft while the advancing blade is still climbing as it goes forward. The resulting low aft blade and high forward blade become a rapid aft tilting of the rotor disc sometimes referred to as "rotor blow-back". Also, as the helicopter begins to fall, the upward flow of air under the tail surfaces tends to pitch the aircraft nose-down. These two effects, combined with aft cyclic by the pilot attempting to keep the nose from dropping, will frequently allow the rotor blades to blow back and chop off the tailboom as the stalled helicopter falls. Due to the magnitude of the forces involved and the flexibility of rotor blades, rotor teeter stops will not prevent the boom chop. The resulting boom chop, however, is academic, as the aircraft and its occupants are already doomed by the stalled rotor before the chop occurs.

Appendix E – Safety Notice SN-25

ROBINSON
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Safety Notice SN-25

Issued: Dec 86 Rev: Nov 99

CARBURETOR ICE

Carburetor ice can cause engine stoppage and is most likely to occur when there is high humidity or visible moisture and air temperature is below 70°F (21°C). When these conditions exist, the following precautions must be taken:

During Takeoff - Unlike airplanes, which take off at wide open throttle, helicopters take off using only power as required, making them vulnerable to carb ice, especially when engine and induction system are still cold. Use full carb heat (it is filtered) during engine warm-up to preheat induction system and then apply carb heat as required during hover and takeoff to keep CAT gage out of yellow arc.

During Climb or Cruise - Apply carb heat as required to keep CAT gage out of yellow arc.

During Descent or Autorotation -

R22 - Below 18 inches manifold pressure, ignore CAT gage and apply full carb heat.

R44 - Apply carb heat as required to keep CAT gage out of yellow arc and full carb heat when there is visible moisture.

Appendix F – Safety Notice SN-26

ROBINSON
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Safety Notice SN-26

Issued: Jan 87 Rev: Jun 94

NIGHT FLIGHT PLUS BAD WEATHER CAN BE DEADLY

Many fatal accidents have occurred at night when the pilot attempted to fly in marginal weather after dark. The fatal accident rate during night flight is many times higher than during daylight hours.

When it is dark, the pilot cannot see wires or the bottom of clouds, nor low hanging scud or fog. Even when he does see it, he is unable to judge its altitude because there is no horizon for reference. He doesn't realize it is there until he has actually flown into it and suddenly loses his outside visual references and his ability to control the attitude of the helicopter. As helicopters are not inherently stable and have very high roll rates, the aircraft will quickly go out of control, resulting in a high velocity crash which is usually fatal.

Be sure you NEVER fly at night unless you have clear weather with unlimited or very high ceilings and plenty of celestial or ground lights for reference.

Appendix G – Safety Notice SN-31

ROBINSON
HELICOPTER COMPANY

Safety Notice SN-31

Issued: Dec 96

GOVERNOR CAN MASK CARB ICE

With throttle governor on, carb ice will not become apparent as a loss of either RPM or manifold pressure. The governor will automatically adjust throttle to maintain constant RPM which will also result in constant manifold pressure. When in doubt, apply carb heat as required to keep CAT out of yellow arc during hover, climb, or cruise, and apply full carb heat when manifold pressure is below 18 inches.

Also remember, if carb heat assist is used it will reduce carb heat when you lift off to a hover and the control may require readjustment in flight.