



Aviation Safety

Letter

Learn from the mistakes of others and avoid making them yourself . . .

Issue 2/2001

Mid-Air Collision

On December 7, 1997, following a pleasure flight in the area of Saint-Hubert, Quebec, a Cessna 150 (C150) joined the left-hand circuit downwind for Runway 29 at Mascouche Airport, Quebec, to come to a complete stop. At the same time, a Cessna 172 (C172), took off from Runway 29 to conduct touch-and-go landings on the runway following a left-hand circuit. The two aircraft collided in flight on the final leg for Runway 29 and crashed. There were two occupants on board each aircraft, and all four suffered fatal injuries. This synopsis is based on the Transportation Safety Board of Canada (TSB) Final Report A97Q0250.

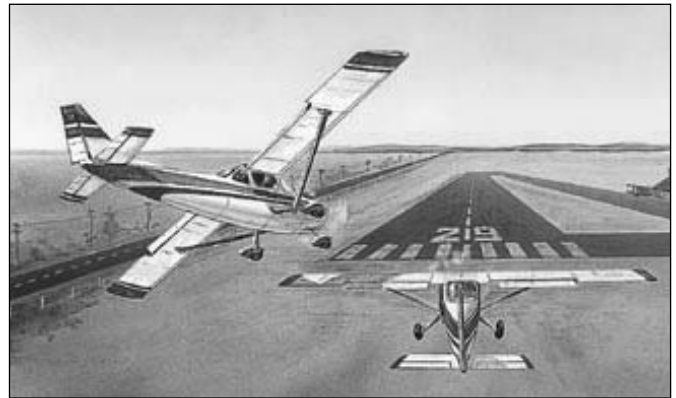
The pilot of the C172 held a Class 3 Instructor Licence—Aeroplane Category. He had accumulated over 2500 hours' flight time at the time of the occurrence. The instructor was to review exercises in the circuit before letting the student pilot make a solo flight. The student pilot had a little over 21 hours' flight time. The pilot of the C150 had owned the aircraft since April 1997 and held a private licence. He had begun his training in September 1994 and had accumulated over 200 hours' flight time. He had brought a passenger with him.

The weather was VFR and conditions favoured the use of Runway 29. Both aircraft had joined a left-hand circuit for Runway 29 at Mascouche. Another aircraft was preceding them, but it was on the ground, clear of the runway, by the time of the accident.

Data gathered from radar at the Montreal area control centre made it possible to reconstruct the following information:

1420:51—The C150, arriving from the Saint-Hubert area, made a long detour northwards to approach Mascouche Airport on the upwind side of the circuit as the C172 took off from Runway 29.

1421:49—When the C150 joined the left-hand downwind leg for Runway 29, it was preceded by another aircraft, which would have been first in the



landing sequence. At that time, the C172 began its turn for the crosswind leg.

1423:11—The C150 stretched its downwind leg while the aircraft ahead of it turned on the final leg. This aircraft would come to a complete stop. The C172 began the left-hand downwind leg for Runway 29.

1424:38—The C150 was now established on the final leg about 5.8 NM from the end of the runway while the C172 was established on the base leg.

1425:17—When the C172 turned on the final leg, it was four nautical miles from the end of the runway. The C150 was ahead of it but at a lower altitude. The approach speed of the C172 was higher than that of the C150.

1426:00—The radar identified only one target and then none.

At the time of the occurrence, a camera in a police patrol car captured images of the collision showing that, shortly after the initial impact, the two aircraft adopted a high nose-up, almost vertical, attitude. The aircraft appeared to become entangled and then separated again just before hitting the ground. When they separated, there was insufficient altitude available for either aircraft to effect a recovery. Measurements taken from the videotape's digitized images show that the aircraft were at an altitude of

450 ft AGL at the time of impact. The images confirm that the C172 was higher than the C150. The images also confirm that the C172's landing light was on at the time of the mid-air collision while that of the C150 was off.

The use of the landing lights, both during the day and at night, greatly enhances the probability of the aircraft's being seen. Transport Canada recommends that pilots use the landing light during the take-off and landing phases and when flying below 2000 ft within terminal areas or control zones. The landing light of the C172 was on, thereby increasing the possibility of its being identified by the C150 during certain phases of flight. This advantage, however, proved useless when the aircraft were on the final leg because the C172 was behind and above the C150.

The two aircraft crashed 2000 ft from the runway threshold. After the accident, the C150 had several laceration marks—caused by a propeller—on the top of the cabin; the aircraft's structure was very damaged. The two aircraft used two-way VHF communication radios, which allowed them to communicate on the frequency employed by crews using Mascouche Airport. Mascouche Airport does not have a control tower or a two-way communication recording system.

Section 602.101 of the *Canadian Aviation Regulations* (CARs) specifies the procedures to join the circuit at an uncontrolled airport lying within a mandatory frequency (MF) area, and CAR 602.102 specifies the procedures for aircraft flying continuous circuits. The information gathered indicates that the crews established radio communication on entering the circuit, on the downwind leg and on the final leg, as prescribed in the regulations.

Crew attention is a determining factor in collision avoidance.

Good scanning technique is required, as is looking outside the cockpit as often as possible. Close attention to radio communications helps form a mental image of the surrounding traffic and reduces the risks of collision.

Analysis—Although the C150's pilot was arriving from the south, he had bypassed the airport in a long detour to the east in order to approach the airport on the north side and join the Runway 29 circuit. Thus, he followed the procedure for joining the circuit at an uncontrolled aerodrome in every respect, just as the pilot of the C172 was following the procedure for continuous circuits. Furthermore, the aircraft reported where they were supposed to.

The pilot of the C150 knew that another aircraft was ahead of him and probably decided to stretch out his downwind leg to give this aircraft time to touch down and clear the runway. The crew of the C172 did not stretch their downwind leg to follow the aircraft ahead. The crew may have confused the traffic that had just landed with the C150, still in the circuit, or perhaps they were not attentive to the communications that would have allowed them to know what aircraft were ahead.

The crew of each aircraft could have seen the other aircraft at several places in the circuit. The pilot of the C150 could have seen the C172 when he turned onto the base leg and after his turn onto the final leg. The pilot of the C172 could have seen the C150 while the C172 was on the downwind leg and during its descent on the base leg. Visual flight is limited by the ability to see and be seen. Several factors can alter a pilot's chances of seeing and being seen, such as the appearance of the aircraft, the environment, or a lack of attention or operation of the radios; any of these could explain the collision, but no single factor could be identified

in the investigation. The lack of evasive action by either aircraft indicates that neither aircraft had noticed the other.

The TSB recently issued another final report on a nearly identical mid-air collision, Report A99P0056. On May 16, 1999, a Cessna 172, with one passenger on board, was conducting left-hand circuits to Runway 32 at 108 Mile Airport, B.C. Shortly after it turned onto final and descended toward the runway, the aircraft collided with a second Cessna 172, which was inbound to the airport from the south on an established straight-in approach to the same runway. The collision took place at about 300 ft AGL. Both aircraft were locked together by the collision and became uncontrollable. They descended at a steep angle and crashed about 2000 ft south of the approach end of the runway and about 500 ft east of the runway's extended centreline.

A TSB review of mid-air collisions that occurred between August 1989 and August 1999 indicates that there were 17 accidents of this type in Canada during this 10-year period. Of these accidents, eight involved some form of formation flight. Of the remaining nine accidents, three occurred in practice training areas and six occurred in the vicinity of uncontrolled airports between aircraft that were not associated with each other.

Following a mid-air collision in 1995, the TSB recommended that Transport Canada (TC) ensure that aircraft are flown at reduced airspeeds, consistent with safe manoeuvring, in the vicinity of aerodromes where separation relies primarily on the see-and-avoid concept. The TSB further recommended that TC take both long- and short-term action to increase the ability of pilots to recognize in-flight collision geometry and optimize avoidance manoeuvring.

TC responded positively to both recommendations. In 1996,



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Sécurité aérienne — Nouvelles est la version française de cette publication.

TC published four articles about collision avoidance in issue 2/96 of the *Aviation Safety Letter*. Additionally, TC has provided relevant information in the *A.I.P. Canada* and has produced and distributed a poster entitled "Uncontrolled Aerodrome VFR Circuit Procedures" to highlight and review applicable pilot reporting and communication requirements within MF and ATF areas. More recently, TC has published a series of manuals on human factors in aviation; developed a video on procedures to be used at uncontrolled aerodromes, titled *A Simple Mistake*; and amended the *Flight Instructor Guide* to provide more comprehensive training and education in related issues.

Recently, there have been three in-flight collisions in

British Columbia involving a total of six aircraft and 12 people. All but three of the people involved died in the accidents. With the increasing concerns brought on by these accidents, NAV CANADA developed, and recently began conducting, pilot education sessions on air traffic procedures that are used at controlled and uncontrolled aerodromes. Both the TSB and TC have participated in these sessions to provide information on recent mid-air collisions and on the limitations of human recognition and response. This active program is expected to raise the awareness of operators, owners, and pilots of the importance of using all available equipment and procedures to reduce the risk of an in-flight collision. △

The Importance of Homework

Reprinted with permission from the September 1999 issue of Callback, the monthly safety newsletter from the office of NASA's Aviation Safety Reporting System.

Lack of preparation for flight into marginal conditions can contribute to a loss of situational awareness that, in turn, can build to a near-catastrophe. The pilot of a private jet, who was the victim of a critical instrument failure, explains.

Localized area of moderate/heavy rain near and over destination airport. The centre controller reported, "it's only heavy rain, there's nothing in it." This was consistent with the pattern of the previous day or two. Carried out normal VOR [very high frequency omnidirectional range] approach using autopilot/flight director. At the missed approach point, began to climb on autopilot. Encountered very heavy rain, moderate turbulence. At approximately 700 ft MSL (250 ft above

minima) ADI [attitude direction indicator] failed with loss of all autopilot/flight director functions. Pilot had difficulty maintaining precise control over aircraft using backup instruments due to turbulence and loss of position and attitude guidance.

Contributing factors:

- 1) backup instruments not set up for missed approach;
- 2) pilot did not study and prepare adequately for missed approach;
- 3) lack of situational awareness when talking with controller due to lack of familiarity with nearby landmarks, fixes and waypoints.

Corrective actions: Training should include setting up backup navigation indicators for approach/missed approach in anticipation of primary ADI/HSI [horizontal situation indicator] failure. Pilots need to thoroughly memorize and set up the missed approach [procedure] because an emergency or equipment failure does not leave time to read it while executing. △

Know Your RASOs—Edgar Allain and André Vautour, Atlantic Region



Edgar Allain



André Vautour

Edgar Allain began his flying career with the Air Cadet program, receiving his glider licence in 1977. He earned his private pilot licence in 1978 and was a glider instructor in 1982. In 1983, Edgar completed his commercial licence and flight instructor rating and began working as a part-time instructor and fire patrol pilot for the Moncton Flying Club. In December 1987, he graduated from Embry-Riddle Aeronautical University with a Bachelor's degree in Aviation Administration. Since then, he has been involved in flight school management and charter operation from 1991 to 1994. Airline experience over the past seven years

included operations in Dash 8, BAE 146 and B757 aircraft. Edgar joined Transport Canada in October 1999.

André Vautour also started in aviation through the Air Cadet program in the mid-seventies. In 1980, he joined the Canadian Air Force and completed pilot training in 1982. He was employed as a Labrador helicopter pilot, where he accumulated over 14 years of experience as a crew commander flying search and rescue missions on the East Coast of Canada. In 1998, André further expanded his aviation knowledge by flying Twin-Otters in a transport role throughout the Arctic region. In his twenty years with the military, André has continuously been involved with different facets of flight safety. André holds airline transport pilot licences in both fixed-wing and rotary-wing aircraft categories, and he joined Transport Canada in October 2000.

Both Edgar and André look forward to working with all segments of our industry. You are encouraged to voice your safety concerns or comments to Edgar or André in Moncton at (506) 851-7110. △

Commentary—Assumptions May Be Hazardous to Your Health

By Harry Weisberger. Originally published in the December 2000 issue, of *Aviation International News* (www.ainonline.com), page 2. Reprinted with permission.

If you mistakenly assume that your mate mailed this month's mortgage payment, probably the worst that will happen is a late charge. "Oh, didn't you lock the door when we left?" or "I thought you turned off the stove" are other assumptions whose consequences could range from serious to none at all. However, it could literally be fatal for a pilot to assume that an IFR clearance automatically shields him [or her] from all traffic.

The fact is, when you are on an IFR clearance, the FAA guarantees you separation only from other IFR traffic. Separation from VFR traffic depends on controller workload.

The crew of a Gulfstream III learned that fact first-hand when, on October 17 over California's San Fernando Valley, they traded paint with a King Air C90. The encounter damaged the King Air enough to qualify as an accident, and missed being a fatal mid-air by mere inches. The Gulfstream, inbound for Van Nuys Airport (VNY) on an IFR flight plan, had been handed off to Van Nuys Tower and cleared for a Runway 16R ILS approach—an IFR operation from start to finish. The collision occurred at about 3500 ft MSL, some four miles from the runway threshold.

So how did the VFR King Air happen to show up under the GIII's left wing? The NTSB, FAA and perhaps a court of law could take a while to sort that

one out. The King Air pilot's version differs from those of the Gulfstream PIC and a witness on the ground. Regardless, no one warned either aircraft that they were about to assume joint tenancy of the same piece of airspace.

No matter the cause, whether it's a momentarily distracted controller or a pilot looking down to check a chart, copy a clearance or change a frequency—or any combination of factors—the bottom line is an IFR clearance is supposed to guarantee you separation only from other IFR aircraft.

That's it. Being IFR doesn't grant blanket immunity to "your" airspace from VFR intrusions, although controllers may offer advisories on nearby VFR aircraft as workload permits.

Notice an IFR clearance "is supposed" to guarantee separation from other IFR aircraft. Blind faith that it always will is another assumption that could be your last. Mistakes are made. Stuff happens.

Some of the worst mid-air, in terms of lives lost, have involved IFR airliners and VFR general aviation [GA] airplanes. The most infamous airline/GA mid-air occurred on the morning of Sept. 25, 1978, when a Pacific Southwest Airlines Boeing 727, on downwind for Lindbergh Field, and a Cessna 172 collided over the North Park district of San Diego. The pilot and flight instructor in the Cessna perished along with all 148 aboard the PSA jet. This disaster

led directly and immediately to the establishment of terminal control areas (TCA) around major airports (now Class B airspace).

In this classic IFR vs. VFR mid-air, each aircraft was under different control—the 172 with Lindbergh Tower, the 727 assigned to a San Diego approach controller. The latter’s procedures manual did not require him to separate the IFR airliner under his control from the VFR aircraft on his scope.

Two other well publicized accidents, each killing 82, were the Piedmont 727/Cessna 310 accident on July 19, 1967, near Hendersonville, N.C., and the Aeromexico DC-9 (on approach to LAX)/Piper Arrow accident on Aug. 31, 1986, over Cerritos, Calif. The Arrow had busted the TCA altitude by only a few hundred feet, and this mid-air led directly to the FAA TCAS II mandate.

Today, FAA separation procedures vary between airports according to terrain, traffic volume and mix of aircraft, although the dimensions of protected airspace around IFR aircraft—400 to 740 ft vertically (depending on altitude) and laterally (time-based)—are the same everywhere. FAA officials offer no eye-

opening revelations for preventing low-altitude IFR vs. VFR encounters, except to keep your eyes open and follow the tried-and-true: if VFR, keep your head on a swivel; if you’re multi-pilot IFR, keep the PNF’s head on a swivel. Communicate your position and intentions, and harken to the position and intentions of others.

A more recent example of a disastrous conflict between IFR and VFR traffic is the 1998 collision between an IFR Citationjet and a VFR [Cessna] 172 over Georgia. The transponder in the 172 was not switched on, and although the 172’s primary target was visible on ATC radar, no advisory was passed to the crew of the Citationjet.

So can we expect technology to protect us? TCAS is nice, but not all aircraft have it. And it doesn’t always show everything out there. (Just ask the aforementioned GIII crew.) Sure, technology can help, but it’s never been an absolute cure-all.

The moral of this story is simple: assume nothing; expect anything; and never let yourself think that an IFR clearance automatically makes you collision-proof. △

Accident Statistics—A Quick Look

Back in *Aviation Safety Letter* issue 3/99, we discussed how we, as an industry, could reduce the accident statistics. We showed statistics for a five-year period (1994–1998), indicating the total number of accidents for Canadian-registered aircraft per year, the total number of fatalities per year, and the five-year average for each. The numbers we had at the time indicated a fairly constant trend over that five-year period; however, take a look at the same numbers below, with the addition of the 1999 and 2000 data.

	Accidents	Fatalities
1994	380	80
1995	390	107
1996	342	70
1997	353	77
1998	383	83
1999	342	66
2000	322	63

Source: Transportation Safety Board of Canada (TSB)

According to these numbers, we did quite well over the last couple of years. The five-year average went from 370 accidents for the 1994–1998 period, to 348 for the 1996–2000. The five-year averages for fatalities, in the same time periods, went from 83 to 72. Considering that these numbers are averaged over five years, the decreases are fairly significant and indicate that we seem to be on the right track.

Even more significant were the decreases in the number of accidents in the commuter and air taxi sectors of the industry. The commuter sector went from 13 accidents in 1999 to five in 2000, while the air taxi segment went from 70 accidents in 1999 to

46 in 2000. These two specific decreases are extremely good news to the industry as a whole. However, as good as the commercial aviation numbers are, the private sector did not fare so well. We had 172 accidents in the private sector in 1999 and 180 in 2000, while the 1995–1999 five-year average is 159. With the busy flying season just ahead of us, it may be an opportune time for all private pilots and operators to reflect on how those numbers could be improved. Occurrence statistics can be found on the TSB Web site at <<http://www.tsb.gc.ca>>.

Nearly two years ago already, Transport Canada implemented *Flight 2005: A Civil Aviation Safety Framework for Canada*, which set measurable targets to determine success. Among those, targets for commuter and air taxi sectors of the industry were aggressively set at 50% decreases in the five-year accident-rate averages. Given the numbers shown above for 1999 and 2000, it is very encouraging to see that we may not only reach those targets, but we may also surpass them. Of course Flight 2005 is only one element of the larger picture, but we are confident that the concepts brought forward within the safety framework, and the introduction of safety management systems, have positively affected safety attitudes throughout industry and contributed to the decrease in accidents. The Canadian Aviation Safety Seminar (CASS) 2001, scheduled for May 14 to 16, 2001, in Ottawa, Ontario, will focus on the implementation of safety management systems. For more information on Flight 2005 and CASS 2001, visit our Web site at <http://www.tc.gc.ca/aviation/index_e.htm>. △

Anatomy of a Runway Incursion

On Feb. 27, 1999, the pilot of a Cessna 172 (C172) took off without take-off clearance from Runway 25 at Calgary International Airport, Alberta, while an Airbus A319 had just been cleared for takeoff on an intersecting runway, Runway 16. The Calgary Tower air traffic controller advised the pilot of the C172 to abort, but with no apparent response. He then advised the pilot of the Airbus to abort. The Airbus was at about 120 kt and came to a stop with about one-half of the runway length remaining. Emergency Response Services (ERS) were requested to respond as a precaution because of the potential for hot brakes. This synopsis is based on the Transportation Safety Board of Canada (TSB) Final Report A99W0036.

The pilot of C172 was a licensed private pilot with approximately 75 to 80 hr. of flight experience. He had acquired his private licence in Nov. 1998 and was in the process of building his flight time in order to qualify for a commercial licence. He had flown four to five hours in the previous ten days. While taxiing, he had been authorized to backtrack on Runway 25 from taxiway "C", behind another Cessna, which was also backtracking on Runway 25. The controller advised the pilot of the C172 that he was first for takeoff because the other aircraft was to backtrack all the way to the end. The pilot of the C172 backtracked about 400 ft and had about 1000 ft from the beginning of his take-off run until reaching the intersection of Runway 16/34.

The pilot of C172 was not aware that the Airbus was in position on Runway 16 and did not hear the take-off clearance issued to that aircraft even though the clearance was issued on the same frequency that C172 was monitoring. Believing he had authorization to take off, he

applied power and began the take-off roll. He looked to his right and saw the Airbus but wasn't sure that it was moving. He convinced himself that, in any event, he could not stop before Runway 16 and continued the takeoff. After advising the tower that he was rolling, he did not hear the instruction to stop or abort his takeoff.

NAV CANADA's *ATC MANOPS* provides authorization for controllers to position aircraft on intersecting runways for takeoff as long as they use proper phraseology to avoid confusion. After the pilot of the C172 advised the controller that he would backtrack Runway 25 for 400 ft, the controller should have said "call-sign, number two for departure, traffic A319 departing Runway 16." No mention was made to the pilot of the C172 that the Airbus would be first to depart. Twenty-one seconds later, after performing the mandatory runway scan to ensure the runway was clear, the controller issued a take-off clearance to the Airbus. The controller then diverted his attention to record departure times in the automated aircraft movement system. The controller did not observe the simultaneous movement of both of the aircraft until the pilot of the C172 advised that he was rolling on Runway 25.

The controller issued urgent instructions to the pilot of the C172 to abort takeoff, using the phraseology in accordance with *ATC MANOPS*. When he received no response or indication of compliance, he was concerned that, if the pilot did stop, the smaller aircraft might stop on Runway 16 in the path of the Airbus. He then requested the Airbus pilot to abort takeoff as well.

The distance from the button of Runway 16 to its intersection with Runway 25 is approximately 9800 ft. Under the

existing environmental and aircraft conditions, an Airbus A319 taking off at Calgary, assuming normal operations, would require 4612 ft to become airborne and would cross Runway 25 (approximately 9000 ft from the beginning of the take-off roll) at 600 ft AGL. A Cessna 172, in the conditions of the occurrence, would require approximately 850 ft to become airborne, and 1000 ft after beginning its take-off roll it would be at less than 200 ft above ground.

The pilot of the C172 reported that several issues associated with this occurrence were different from his expectations. He had originally expected to taxi for Runway 16 because he knew it was the active runway; when he was offered Runway 25, he accepted. Upon reaching the hold point for Runway 25, he was immediately and unexpectedly offered the opportunity to backtrack Runway 25 and to depart before the Cessna ahead, which he also accepted. His experience was that, normally, when cleared to line up on the runway but not cleared for take-off, he would hear the expression "taxi to position" or something similar. In this case, to clear the C172 onto the runway, the controller used the phraseology, "call-sign, right turn, backtrack to position Runway two five, how far back do you require?"

The pilot of the C172 reported that he had previously, during the busy few seconds when an *ab initio* pilot is positioning on a runway for takeoff, had trouble distinguishing the executive order to take off from all of the other verbiage that is issued by the control agency. In these circumstances, he had been prompted to take off without delay by the instructor. Having taken flying training in Calgary, at a busy airport, he was accustomed to expediting the take-off process once on the runway.

A new chapter (Exercise 30) in the fourth edition (1999) of the Transport Canada (TC) *Flight Training Manual* now covers radio communications in some detail, and the topic is mentioned briefly in TC's *Flight Instructor's Guide*. The *Flight Training Manual* warns pilots that "By keeping a good listening watch on the frequency you maintain situational awareness, which assists in identifying potential traffic conflict." The training school where the private pilot took his flying training does not target radio procedures in the private pilot syllabus and expects students to pick up the necessary expertise as they progress through the flying training lesson plans.

Analysis—The pilot of the C172 was relatively inexperienced and not yet completely familiar with the speed and complexity of radio communications and the radio monitoring requirements at Calgary International Airport. His previous experience had prepared him to believe that, once on a runway, he was expected to carry out the take-off procedure without delay. On several occasions in the past, he had also missed the executive portion of the take-off clearance commu-

nication, "cleared for takeoff," and had been prompted by the instructor to begin takeoff. In this situation, he assumed that he had similarly missed the clearance amid the other verbiage. The runway had just been made available to him, the only other traffic that he was aware of was behind him, and he had been told that he was "number one." He assumed that he had been cleared for takeoff even though he had not heard the specific words. The information held by the controller, but not conveyed to the C172, that he was actually number two for departure, followed by the identification of the traffic that was number one, would likely have provided a sufficient situational update to the pilot of the C172.

The radio skills and heightened situational awareness necessary to operate on the surface or in the near vicinity of Calgary International Airport are not specifically targeted during private pilot training at the unit where the pilot trained, but they are expected to be acquired by exposure to the various situations encountered during training. This procedure may not ensure sufficient familiarity with all the common safety-related

circumstances or practices that a student or newly licensed private pilot should be aware of. Those situations that are experienced may not be presented with enough emphasis to convince inexperienced pilots to devise methods to assure themselves that all appropriate clearances and instructions have been followed.

While entering take-off information for the Airbus, the controller momentarily diverted his attention from the activity on the runways. Additional inside administrative duties, which detract from outside visual monitoring, reduce the level of safety oversight that the controller should provide.

The TSB determined that the pilot of the C172 took off without clearance and without ensuring that it was safe to do so. Contributing to the unauthorized takeoff were the lack of appropriate training concerning the need for clear communications during unfamiliar situations, the lack of appropriate training concerning the distractions that can diminish situational awareness when operating at a busy airport, and the use of non-standard phraseology by the tower air traffic controller. △

The Perils of Unapproved GPS

By Shawn Coyle, Engineering Test Pilot, Transport Canada

Recently one of our readers sent a letter outlining problems with a hand-held global positioning system (GPS). Basically the problems were with the map display. It appears this particular model showed highways in the incorrect location, and the Toronto Island airport was shown far out into the lake. The manufacturer of the equipment blamed the database (which they obtain from another supplier), but other hand-held GPSs that use the same database were correct. What lessons are to be learned from this? For those who supplement their IFR navigation with hand-held GPS units, remember they are very different from IFR-approved GPS receivers. Hand-held GPSs are not subject to any certification process, and while they are useful, they are not a substitute for standard IFR navigation instruments or proper VFR map reading. Hand-held GPSs have no self-monitoring to tell you that the satellite geometry may be less than optimum. There have been reports of errors of up to 80 NM with hand-held GPSs. GPS is a very useful tool, but it is not without its pitfalls. △



Helicopter Safety—Asking for a Wire Strike



Artist's impression of moment before the wire strike

On February 26, 1999, the pilot and a two-person film crew were conducting an aerial photographic flight to film train traffic in the area near Hinton, Alberta. As a train approached Entrance, Alberta, about five miles west of Hinton, the pilot manoeuvred the helicopter over the train cars. Once directly over the cars and about 40 cars behind the locomotives, the pilot descended the helicopter to a skid height of about 12 ft above the rolling stock and adjusted his flight speed so that he was slowly overtaking the locomotives. About 30 seconds into the film run, the helicopter struck two steel electrical wire conductors that crossed the rail line at a 90° angle. The wires contacted the helicopter just above the windshield and moved aft into the pitch control rods and main rotor mast. The pitch control rods were severed and aircraft control was lost. The aircraft pitched up, yawed left, then right, and descended in a 45° nose-down attitude, striking the ground about 90 ft left of the passing train and about 600 ft beyond the point where the wire strike occurred. All occupants of the aircraft were wearing both lap and

shoulder harnesses, and the pilot was wearing a helmet. The passenger in the left front seat sustained serious injuries, and the pilot and other passenger, in a rear seat, received minor injuries. The helicopter was substantially damaged. This synopsis is based on the Transportation Safety Board of Canada (TSB) Final Report A99W0034.

On the morning of the occurrence, the pilot attended a pre-flight briefing, also attended by members of the filming crew, including their ground support staff, the helicopter operator's management, and rail staff. During the briefing, the pilot was cautioned by the rail staff to be judicious in his choice of altitude when overflying the train. The film director requested that the pilot fly as low and as fast as possible, while remaining consistent with flight safety. For the flight, the pilot occupied the right pilot seat; the cameraman, the left front seat; and the film director, the right rear seat. The film crew was briefed on normal and emergency procedures.

The pilot flew to the west of Hinton, where the crew planned on filming a westbound train.

Initially, the train was filmed with the helicopter situated in a hover alongside a trestle. The helicopter then moved vertically and into forward flight while passing over the train. As the train moved under a highway crossing, the helicopter made a right-hand 360° turn, manoeuvred directly over the train, and descended to a skid height of about 12 ft above the rail cars. Shortly thereafter, the helicopter struck the two steel wire conductors.

The wires were about 35 ft above the tracks, supported by poles 75 m from the tracks. The pole to the south could not have been seen by the pilot, and the pole to the north could have been seen for about four seconds before the wire strike occurred. The wires were oxidized, and the background to the wires was dull terrain and trees. The wires were not distinguishable from the background prior to the impact in the film that was taken during the flight.

Before all the filming runs, except the last run, the pilot carried out an aerial reconnaissance of the area to check for wires and other obstructions. Just before the last pass, the train was entering an area with a view of the mountains in the distance. The rails continued in a westward direction for several miles, thus providing a clear view of the mountains in the background for several minutes as the train moved westward. The pilot, in consultation with the film director, decided that, if one final pass was made, filming would be completed. The wire strike occurred about 30 seconds before the run was to have been terminated.

Analysis—Based on the type of flying that was planned and executed, the pilot was aware that obstacles, such as wires crossing the rail tracks, were his primary concern during low-altitude operations. The pilot

stated that he had carried out aerial reconnaissance of all the film runs except the last one. The area beyond where the film run was started provided several miles of track where an aerial reconnaissance could have been completed and the filming requirements met. The pilot's decision to complete the task without

conducting an aerial reconnaissance resulted in his overlooking a vital safety precaution.

The helicopter was not equipped with a wire strike protection system (WSPS). The helicopter struck the wire at a position where a WSPS probably would have cut the wire. The TSB determined that the pilot

had been briefed that he should not overfly the train at low altitude, that the pilot and company chief pilot had discussed the hazards of low flight before the beginning of the operation, and that the pilot did not conduct a reconnaissance flight of the portion of track being used for the final film run. △

Upcoming Regional Events.

The following schedule for upcoming courses and/or workshops is tentative. Please contact your regional office for exact location and cost.

Crew Resource Management (CRM). This course is designed to provide knowledge and skills by using all available resources to achieve safe, efficient flight. The course covers the topics for initial training as identified in paragraph 725.124(39)(a) of the *Commercial Air Service Standards*.

Company Aviation Safety Officer (CASO). This program is designed to provide both the theory and practical application of topics such as incident reporting, tracking and analysis; the company safety survey; risk-management concepts; accident prevention; the safety committee; and emergency response planning. This course covers the topics as identified in subsection 725.07(3) of the *Commercial Air Service Standards* (Air Operator Flight Safety Program). System Safety offers one free seat to each CEO, Operations Manager, Chief Pilot, Chief of Maintenance or Chief Flight Attendant for every company employee that attends.

Pilot Decision Making (PDM). This course covers the decision-making process, hazardous attitudes and behaviour, judgment, risk-management and communication skills. It satisfies the requirement of section 723.28 of the *Commercial Air Service Standards*, VFR Flight Minima—Uncontrolled Airspace, for a recognized pilot decision-making course.

Human Performance in Aviation Maintenance (HPIAM). The concept of HPIAM is to provide awareness to the maintenance personnel and management in order to reduce an accident or incident.

Atlantic Region

PDM June 9 Charlottetown, Prince Edward Island

Courses and workshops are available on demand. For further information, please contact Rosemary Landry at (506) 851-7110 or e-mail landryr@tc.gc.ca.

Quebec Region

Skills Review Seminars—Flying: Risk factors and decision making (in French)

April 18	Sept-Îles	May 1	St-Jean-sur-le-Richelieu (Balloons)
April 26	Dolbeau	May 9	Mascouche
April 27	Trois-Rivières	May 23	Dorval

For more information or to register, please call (514) 633-3249 or e-mail qcsecursys@tc.gc.ca.

Ontario Region

CRM May 17–18 Ottawa

CASO May 24–25 Toronto

Pre-float Seminar Spring/Summer Flight Preparation

April 18 Toronto May 16 Brampton

For information or to register for the above courses, please call (416) 952-0175 or e-mail neln@tc.gc.ca.

Prairie & Northern Region (PNR)

Quarterly Regional Aviation Safety Council Meeting June 2001 Calgary, Alberta (Date to be announced)

For information on courses and workshops in PNR, contact Carol Beauchamp at (780) 495-2258 or beaucca@tc.gc.ca; fax: (780) 495-7355.

Pacific Region

PDM Third Thursday of every month Richmond

Every three months Abbotsford (call for next date)

HPIAM April 25–26 Campbell River

May 30–31 Langley

June 14–15 Richmond

September 27–28 Victoria

For information on courses and workshops in Pacific Region, please contact Lisa Pike at (604) 666-9517, toll-free 1-877-640-2233 or pikel@tc.gc.ca; fax: (604) 666-9507.



Self-serve fuel is a fact of life for automobiles; why don't pilots pay more attention to what goes in the tanks?

For many pilots, the end of the flight is the beginning of a routine. They land, taxi to the ramp, go into the FBO [fixed-base operator]. If they're planning another leg, they'll order fuel, use the restroom, check the weather and maybe have a snack. They pay the fuel bill and walk back to the plane. If they're home or planning to spend a day or two, they put in a fuel order and leave.

Sometimes it's the worst thing you can do. For example, a Cessna 421C crashed in good weather in San Antonio, Texas, killing the pilot and one passenger instantly. Another passenger was seriously injured and died several days later. The pilot's gamble came during the pre-flight and engine run-up.

The flight was operating as an air ambulance, carrying a pilot and two nurses. It had made a trip from San Antonio to Del Rio, Texas, earlier that morning and, on its return, the pilot ordered 30 gal. of avgas in each wing tank. He called Flight Service and got a weather briefing, then filed an IFR flight plan to Eagle Pass, Texas, where the airplane and crew were based.

The airplane took off, and within a minute the pilot reported a problem and requested a return to the airport. He was cleared to land, but both engines

were trailing thick black smoke. The plane crashed a half-mile from the runway. An investigation determined that the gasoline in the wing tanks had been contaminated by jet A. Two labs confirmed that the fuel was about half 100LL and half jet fuel.

The FBO's paperwork showed that the aircraft had been serviced with 100LL, but the meter read-

ings on the fuel trucks showed the fuel had been pumped from the jet A truck. Although the airplane was in compliance with AD 87-21-02, which required the installation of fuel filler restrictors in the wing tanks, the FBO's fuel truck was not equipped with a restrictor nozzle. The fuel truck was owned by the fuel vendor and leased by the FBO. The nozzle had been in the vendor's warehouse for two years.

The potential for trouble is there for every pilot. Some pilots routinely supervise the refueling of their airplanes. Some check the filler caps after the fuel is pumped. Some sample the fuel for water before the fuel truck gets there and again after it leaves. Some pilots insist on pumping the gas themselves. Few are the pilots who do all of the above.

Does it show lack of trust? Sure it does. It shows lack of trust in the training of the refueller by the FBO and human factors in general. Think about your home airport and count how many different faces you've seen driving the fuel truck in the past two years.

Verifying that the correct fuel truck is parked in front of your propeller is the first step, but it doesn't stop there. Problems also can be stopped during pre-flight. The fuel sample's odour of kerosene, the separation of the fuel in the tester, the greasy splash where the sample was emptied

on the ramp and the colour are all there to see.

In the case of the Cessna 421, the next chance to break the accident chain came after the engines were started. Cylinder head temperatures would have been very high during taxi and run-up. In any case, the run-up would have shown (after the most casual check of engine instruments) that things were close to meltdown.

The accident report contains no witness accounts that there was or was not a run-up. There are some pilots, particularly among Part 135 [of the U.S. *Federal Aviation Regulations*] operators, who do quick mag checks while they taxi, get clearance and move right out on the active with a rolling takeoff. It has a nice look but can be a deadly game of Russian roulette.

On the take-off roll, the engine gauges probably showed pegged cylinder head temperatures, with the distinct beginnings of detonation well before lift-off speed. The take-off roll was probably much longer than normal. The engines were literally melting down. Once airborne, the right engine went first, and the pilot seemed to be proficient enough to get it feathered promptly, but power was fading fast on the left engine—with full-scale detonation underway.

As the air ambulance settled toward the ground, it approached a small stand of oak trees, surrounded by open field. There may have been too many things going on for the pilot to notice. In any case, the crash was into the trees. A casual glance at the fuel truck is all it would have taken.

Raymond Leis is a certified flight instructor—instrument (CFII) and airline transport pilot with more than 23,000 hr. This article was originally published in the August 2000 issue of Aviation Safety; reprinted with permission. △

Night VFR Part II—The Dark Side of Night Flying *cont. from p. 12*

dents occur during the hours of darkness. It is more difficult to visually detect inclement weather when flying at night. Over a ten-year period, a TSB study found that VFR flight into IMC accounted for only 6% of all aircraft accidents yet was responsible for 26% of fatalities, making this the number one killer in aviation. Why are these accidents so deadly? Once VFR pilots enter cloud, either they fly into terrain while in controlled flight or they experience spatial disorientation and lose control of their aircraft. The latter was presumably the case for the non-instrument-rated pilot of a Cessna 150 who was killed when he struck terrain en route from Spirit River to St. Paul, Alberta. The TSB report indicates the pilot “continued flight into deteriorating weather conditions, probably became disorientated . . . lost control of the aircraft . . . [and] entered a spiral dive from which [he] could not recover.” Since he was flying over a sparsely populated area at night, he would have had difficulty seeing the inclement weather, let alone the ground or horizon.

To avoid flying into IMC, not only should you obtain a thorough pre-flight weather briefing, but you should also carefully monitor any weather changes while en route. Also, you can often detect the formation of low cloud or fog if you see a halo or glow around surface lights.

Approach and Landing—As you near your destination, it is important to understand the risk that darkness brings to the approach and landing phase of flight. It increases significantly when you conduct an approach

in black-hole conditions. A black hole exists on dark nights when there are no surface lights between the aircraft and the runway environment. In these conditions, pilots have a strong tendency to fly too low and could crash short of the runway.

Ever since Dr. Conrad Kraft at Boeing verified this problem in a series of simulator studies in the late 1960s, the hazards of black-hole illusions have been widely publicized in the aviation community. Unfortunately, pilots still fall prey to this visual illusion. For example, while the crew of a C99 Airliner was conducting a visual approach to Moosonee, Ontario, they struck the trees and crashed seven miles short of the runway, killing one crew member and seriously injuring the others on board. In 1991, a Canadian Forces C-130 Hercules struck the terrain several miles short of the airport on a clear night while conducting a visual approach to Canadian Forces Station Alert. The black-hole illusion was cited by the TSB as a causal factor in these accidents.

An upsloping runway increases the black-hole illusion. Recently, the crew of a Boeing 767 was fooled by this illusion while on final approach for an upsloping runway at Halifax International Airport. In spite of proper guidance provided by the precision approach path indicator (PAPI), the crew responded with an unwarranted power reduction, causing the airplane to land short, damaging the tail skid and rear fuselage.

To avoid these illusions, you should supplement your outside visual reference to the runway

with airport approach slope indicators (VASI, PAPI, etc.) or glide path information from your navigation instruments (ILS or GPS). Using distance measuring equipment (DME), you can also fly a three-degree approach angle by remaining 300 ft AGL per nautical mile flown. Also, consider overflying an unfamiliar airport before beginning your approach descent.

Summary—NVFR flight can be a pleasant experience, but the risks are clearly greater. A pilot who died in a typical “dark-night takeoff accident,” had claimed earlier that flying at night was no different than flying during the day. Well there is one difference—you can’t see anything at night! Awareness of the hazards associated with each phase of NVFR flight will help you avoid becoming another statistic. Remember that an illusion, by definition, *deceives* us, so don’t completely trust your senses—use other aids to vision. If you are not instrument-rated, obtain some instrument training and maintain a minimum level of instrument proficiency. If you have an instrument rating, use it; it is your best defense against the hazards of night flying.

Contact your regional System Safety office for the latest on our NVFR safety promotion campaign.

This article is based in part on Dale Wilson’s article, “Darkness Increases Risks of Flight,” published in the Flight Safety Foundation’s (FSF) Nov.-Dec. issue of *Human Factors and Aviation Medicine*, which can be accessed on the FSF Web site at <http://www.flightsafety.org>. <△

Transport Canada’s Canadian Aviation Safety Seminar, CASS 2001

May 14–16, Westin Ottawa hotel

Making Safety Management Systems Work in the 21st Century—Something for Everyone

info/registration: <http://www.tc.gc.ca/aviation/cass2001/>

Night VFR Part II—The Dark Side of Night Flying

By John Heiler, Regional Aviation Safety Officer, Pacific Region; and Dale Wilson, Assistant Professor, Central Washington University. This article is a follow-up to "Night VFR Part I—Do You See The Hazard?" published in ASL 4/2000.

Visual flight rules (VFR) flight is inherently more risky at night than it is during the day. Not only are certain types of accidents more likely at night, but there are also some accidents that occur only after dark. In Part I (ASL 4/2000), we discussed the importance of pre-flight planning and the hazards associated with ground operations at night. This article introduces the major hazards of night VFR (NVFR) operations during the take-off and climb phases of flight, while en route, and during the approach and landing phases of flight.

Takeoff and Climb—A critical hazard after takeoff at night occurs when climbing into black-hole conditions where there are no surface lights and the sky is overcast and/or moonless. Over three-quarters of night takeoff accidents occur during these dark-night conditions. A contributing factor in these accidents is the somatogravic or false climb illusion. When our body is accelerated after takeoff (or during an overshoot), the brain per-

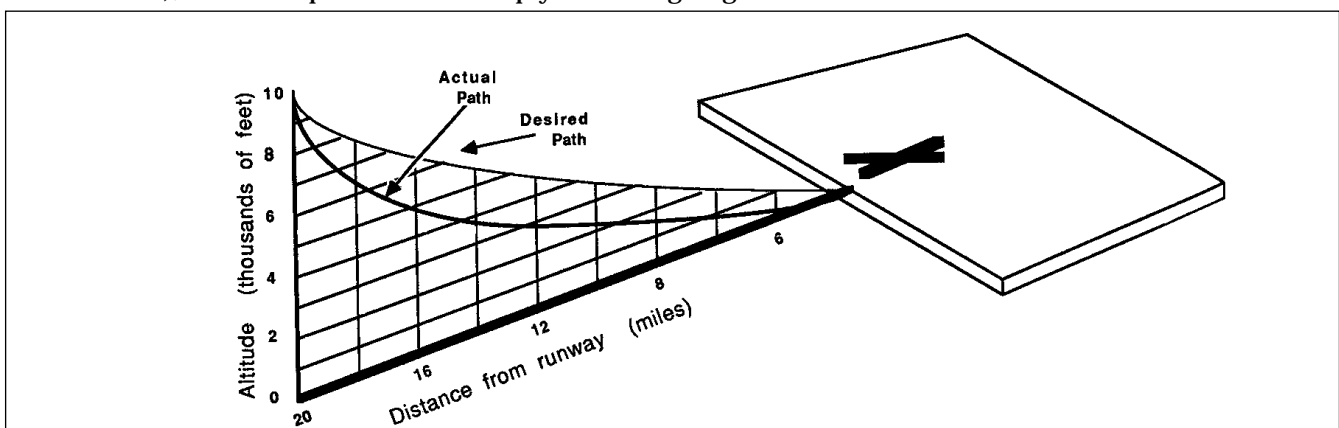
ceives acceleration and gravity as a single force acting both downward and backward. Pilots who experience this pitch-up illusion often respond by pitching the nose down. For example, the pilot of a Cessna T210 Centurion died after his airplane crashed into a frozen lake one and a half miles from the end of the runway after an NVFR departure from Flin Flon, Man. In a similar accident, three people on board a Piper PA-31 Chief-tain were fatally injured when their MEDEVAC flight struck the dark waters of Lake Erie shortly after departing Pelee Island, Ontario. VFR and dark-night conditions prevailed, and the Transportation Safety Board of Canada (TSB) cited the somatogravic illusion as a causal factor in these accidents. Therefore, to ensure a positive rate of climb and safe terrain clearance during the initial climb phase at night, it is important to use your flight instruments until adequate outside visual references are established—do not rely solely on outside visual references.

En route—Reduced ability to see at night also creates hazards during the en route portion of flight. If you are not using radio navigation, it will be more difficult to navigate at night, especially on a dark night. There is simply not enough light to visu-

ally confirm your position, especially in sparsely settled areas. Therefore, you need to use other sources of navigation information, such as VORs, NDBs, and GPS.

It is also difficult to detect terrain at night, even in good weather conditions. Transport Canada recently studied several dark-night accidents that actually occurred in conditions of good visibility, but they happened over sparsely settled areas where there is literally nothing to see! Since it is difficult to visually detect terrain at night, you should plan for a safe obstacle clearance altitude of at least 2000 ft above the appropriate maximum elevation figure (MEF) indicated on your VFR Navigation Chart (VNC). If you are flying on an airway, you should plan for the minimum en route altitude (MEA) indicated on your IFR Navigation Chart. Also, when selecting an altitude, keep in mind that the retina of the eye is the first organ to experience hypoxia. To ensure adequate night vision, it is recommended that supplemental oxygen be used above 5000 ft MSL.

Finally, there is an increased risk of inadvertent flight into instrument meteorological conditions (IMC) at night. Even though an estimated 10% of VFR flight activity occurs at night, a full 30% of VFR-into-IMC acci-



Comparison of the approach path flown by pilots during a night visual approach with the desired altitudes. Altitude is in thousands of feet; distance from the runway is in miles. (After Kraft, 1978.) Illustration reproduced from *Human Factors in Aviation* by Earl Wiener and David Nagel, Academic Press Inc., 1988, with permission.

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PASSENGER SAFETY BRIEFINGS

Why, when and how should pilots present the passenger safety briefing?

Why: The safety briefing serves an important safety purpose for both passengers and crew. Briefings prepare passengers for an emergency by providing them with information about the location and operation of emergency equipment that they may have to operate; and a well-briefed passenger will be better prepared in an emergency, thereby increasing survivability and lessening dependence on the crew to assist them.

When: When passengers are carried, a crew member must provide a standard safety briefing.

How: An oral briefing by a crew member or by audio or audio-visual means.

Content: The required standard safety briefing consists of four elements: *prior to takeoff, after takeoff, in-flight resulting from turbulence and before passenger deplaning.* An individual safety briefing must be provided to a passenger who is unable to receive information contained within the standard safety briefing, such as visually impaired passengers, hearing-impaired passengers, and adults with infants.

Common problems: No public address system; too much noise in the cabin, making it impossible for passengers to hear; short flights, leaving no time for in-flight briefing. If you are facing any of these problems, conduct the briefing before the engine start-up and combine the after takeoff and turbulence portions with the prior to takeoff briefing. For example, inform the passengers that seat belts must be fastened during takeoff, landing, and turbulence and that it is advisable that seat belts remain fastened during the cruise portion of flight.

The passengers appear uninterested? Make the briefing informative and interesting in order to maintain passenger attention. Face the passengers, establish eye contact and speak at a slower-than-normal rate.

Never skip the safety briefing at a passenger's request. Frequent flier passengers are often unaware that equipment locations and operation can vary on the same aircraft type. The time and effort taken in delivering an effective safety briefing benefits both passengers and flight crew.



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TAKE FIVE...

for safety
Five minutes reading
could save your life!

DISTRACTION = DANGER

By Bernard Maugis, System Safety Specialist, Quebec Region

Already in ancient times, Homer described the devastating effects of distraction in the *Odyssey*. To prevent his mariners from being distracted by the song of the Sirens and putting their boat in danger, Odysseus blocked their ears with wax. Nowadays, bus drivers use other strategies to avoid distraction. As a safety measure, and to avoid distracting them, passengers are asked not to speak to bus drivers.

Most of the time, bush and helicopter pilots are alone to carry out all the tasks related to flying the aircraft while, at the same time, they are not isolated from their passengers. Team spirit often leads pilots to interact with passengers. By talking or by bringing their activities on board the aircraft, passengers can become a dangerous source of distraction. As much as possible, pilots must isolate themselves and concentrate on their work by remaining distant. If pilots get involved in their passengers' conversations or activities, their attention is greatly diverted from flying the aircraft. A distracted pilot is no longer able to control the situation, and his/her vigilance, which is essential during an emergency, is compromised. Conversations in flight should be limited to those that are required by the mission at hand—it's a matter of safety. Professional pilots explain this and enforce it from the cockpit. They can take the time to socialize and exchange opinions once they are on the ground.

Here's a classic example of distraction: Imagine the passenger in your helicopter is a geologist. You observe him from the corner of your eye between two "scans" of the instrument panel. You have been flying over a rocky countryside for a good half-hour. Suddenly, he changes colour and yells in the interphone to conduct a half-turn toward a heap of pebbles. You carry out the manoeuvre as an excited voice, raving about the mineral beauty of these rocks, resonates through your headset. The enthusiasm overcomes you as well; your wide eyes fixate on these stones and search to find the beauty in them, but you don't see it—you are not a geologist! Suddenly, you regain your composure and you notice, with a sinking stomach and a strident cuss, that you are at 100 ft AGL with a tailwind and no airspeed. You have put yourself and your passengers in a dangerous situation. You alone are responsible. You let yourself become distracted! You are very lucky if this story has a happy ending. Unfortunately, many fatal accidents (for example, collisions with power lines) have pilot distraction as a causal factor.

Other dangerous forms of pilot distraction include spilled coffee in the cockpit, problems with an instrument, or a passenger who is not feeling well. The pilot diverts his/her attention to the problem while the flight continues with no real control. The longer the flight continues at a low altitude, the more likely it is that this distraction could have disastrous results because the room to manoeuvre is reduced. Pilots, beware of the song of the Sirens!



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