



## Captain's Inadequate Use of Flight Controls During Single-engine Approach and Go-around Results in Loss of Control and Crash of Commuter

*The official report of the Netherlands Aviation Safety Board concluded that the crew was unaware of the consequences of making an approach with one engine in flight idle. Moreover, the crew did not understand the aircraft's engine-oil system. Investigators determined that an oil-pressure switch failed and resulted in cockpit warnings, but there was no evidence of any other failure or defect on the aircraft, including the engines and systems.*

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### Editorial Staff Report

During climbout, the crew of the Saab 340B twin-engine turboprop aircraft observed a right-engine oil-pressure warning light. The crew elected to return to the departure airport, Schiphol Airport, Amsterdam, Netherlands. An instrument landing system (ILS) approach was flown with the right engine in flight idle. During the approach, the captain applied little or no rudder, and the aircraft drifted to the right of the runway. A go-around was executed.

As the aircraft climbed, no rudder was used to compensate for the high asymmetrical thrust, and the aircraft rolled to the right. The aircraft pitch increased, the indicated airspeed dropped and the bank angle increased. The captain lost control, and the aircraft hit the ground in an 80-degree bank. The accident occurred during daylight visual meteorological conditions (VMC). The captain and two passengers were killed, and the first officer (FO) and eight passengers were seriously injured. The cabin attendant and 11 passengers received minor injuries in the April 4, 1994, accident.

The final report of the Netherlands Aviation Safety Board concluded that the probable cause of the accident was the "inadequate use of the flight controls during an asymmetric go-around, resulting in a loss of control." Contributing factors

were the "insufficient understanding [by] the flight crew of the Saab 340B engine-oil system"; the "lack of awareness of the consequences of an aircraft configuration with one engine in flight idle"; and "poor crew resource management."

The Saab 340B was owned and operated by KLM Cityhopper (KLC) Ltd. The accident crew, comprising the captain, FO and a cabin attendant, reported for duty at 0835 hours local time, and flew an uneventful round-trip passenger flight from Amsterdam to Southampton, England, in the accident aircraft, the report said. The crew returned to Amsterdam at 1255 and prepared for their next flight (KL433), from Amsterdam to Cardiff, Wales.

KL433 (the accident flight) departed Amsterdam at approximately 1420, with 21 passengers. The captain was the pilot flying, the report said. KL433 was cleared to 14,000 feet (4,270 meters). Because cloud tops were reported as high as 15,000 feet (4,575 meters), the crew requested flight level (FL) 200 (20,000 feet [6,100 meters]) as a cruising altitude, which was approved by air traffic control (ATC), the report said.

As the flight was climbing through 16,500 feet (5,032 meters), the central warning panel (CWP) light for the right-engine oil

pressure triggered the master warning, the report said. The crew reset the master warning, and the captain retarded the power lever on the right engine to flight idle. The captain announced, "Take action," and the FO "confirmed the command, 'Take action,' and announced, 'Emergency checklist,'" the report said.

The report noted: "The right-engine oil-pressure CWP light indicates a possible low oil pressure in the right engine and/or in the right propeller gear box. The procedure in the Emergency Checklist (ECL) for an engine oil-pressure low warning is therefore a combined procedure. The first item in the procedure is to read the oil-pressure indicators. Any follow-up action depends on these readings."

Less than one minute later, the master warning was triggered a second time, and was reset by the crew, the report said. The FO told the captain that the oil pressure on the right engine was lower than the oil pressure on the left engine, and that the oil pressure on the right engine was decreasing. As the FO announced this, the captain was still retarding the power lever on the right engine, the report said.

Seconds later, "the master warning was triggered for a third time and, after it was reset again, the FO stated to the captain that the oil pressure of the right engine was indeed decreasing," the report said. The FO concluded "that the propeller oil-pressure low procedure was not applicable and he continued with the engine oil-pressure low procedure," the report said.

The FO read the ECL, "Engine oil-pressure control warning panel light on or engine oil pressure below 30 PSI [pounds per square inch]," the report said. The captain responded, "That is not the case, but it [the oil pressure] is still normally in the green, that is what is so strange," the report said. "There were no indications on the CVR [cockpit voice recorder] that the engine oil-pressure low procedure was completed." The CWP light for the right-engine oil pressure stayed on, and the right-engine power lever was in flight idle, "where it would stay for the remainder of the flight," the report said.

At 1432, the captain told the FO, "that he [the captain] would not continue to his destination with an 'engine oil-pressure low' warning," the report said. The FO told the captain that, according to the ECL, "it should be determined whether or not the engine oil pressure was below 30 PSI with the oil-pressure warning light on," the report said.

The report noted: "According to the ECL procedure, the engine must be shut down if the oil-pressure warning light is on and the oil pressure is below 30 PSI. If the warning light is on and the engine oil pressure is above 30 PSI, normal operation should be continued."

The captain then noted that the right-engine oil pressure was above 50 PSI and announced, "Continue normal operation," the report said. "At [1432:54], the captain again told the FO that he did not want to continue the flight to its destination and thereafter back to Amsterdam. The FO agreed. Neither the captain nor the FO expressed a reason for their decision."

Because the climb performance of the aircraft was considerably reduced, "the captain instructed the FO to obtain a clearance to descend to FL 160 [16,000 feet (4,880 meters)], and to inform ATC that KL433 possibly had to return to Amsterdam due to a technical problem," the report said.

The crew then "contacted Amsterdam Radar, starting the message with a PAN-call [using the international radio-communication term indicating urgency], [and] informing them that they had an engine problem and that they [wanted] to maintain FL 160 for a return to Amsterdam," the report said. KL433 was issued a right turn, direct to Schiphol Airport. At approximately 1435, KL433 was cleared to descend to 7,000 feet (2,135 meters) and told to contact Schiphol Approach.

After some discussion with the captain, the FO told the cabin attendant and the passengers "that the aircraft was returning to Amsterdam, and that the aircraft would land in approximately 20 minutes," the report said. The captain, who handled the radio while the FO briefed the passengers, asked Schiphol Approach for a straight-in approach to Runway 6. KL433 was cleared to 2,000 feet (610 meters), and vectored to the ILS Runway 6. When the FO had completed his passenger briefing, "the captain called for the Descent and Approach Checklists," the report said.

One minute later, "Schiphol Approach asked KL433 if they could give any details regarding their situation, and the captain responded that they had an engine oil-pressure problem in engine No. 2, but that the situation was under control," the report said. "When asked by Schiphol Approach if the engine was feathered, the captain stated that the engine was running in flight idle."

At approximately 1439, KL433 was told to contact Schiphol Arrival, which was a separate frequency that was assigned to handle the flight exclusively, the report said. As they descended through 7,500 feet (2,287 meters), the crew was told that the surface wind was 250 at 10 knots, and that they were number one for landing. "In response to the wind read-out from Schiphol Arrival, the FO informed the captain that there would be a tailwind component of 10 knots for landing on Runway 6, which was acknowledged by the captain," the report said.

The crew was instructed to stop their descent at 5,000 feet (1,525 meters) for separation from other traffic. "During level flight at FL 050, the captain stated to the FO that the right[engine] oil

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***The right-engine power lever was in flight idle, "where it would stay for the remainder of the flight."***

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pressure indicated a steady pressure of more than 50 PSI, which was confirmed by the FO, who also informed the captain that he agreed with his decision to return to Amsterdam,” the report said. Moments later, KL433 was cleared to descend to 2,000 feet.

At 1442, KL433 was told, “You are cleared to land for this approach, 10 miles [16 kilometers] to touchdown,” the report said. When the crew leveled at 2,000 feet, “thrust was applied to the [left] engine for the first time since KL433 started its descent from FL 160, and the airspeed was reduced from 180 knots to approximately 155 knots,” the report said. “At this time, the FO mentioned to the captain, ‘Because you are flying flight idle, you probably have less problems than you might have had otherwise,’ to which remark the captain responded with, ‘Yes.’”

At 1443:06, “KL433 intercepted the Runway 6 ILS localizer, after which the gear was selected down, and approximately 78 percent torque was applied on the [left] engine,” the report said. “Shortly thereafter, the Runway 6 ILS glideslope was also intercepted, the flaps were set to 15 degrees and the torque was reduced.” The captain called for the Landing Checklist, the report said.

Just before crossing the outer marker (OM), the flaps were set to 20 degrees, and the landing checklist was completed by the FO. “Passing the OM, the aircraft was established on the Runway 6 ILS in landing configuration, and flying with the autopilot engaged,” the report said. “Torque on the [left] engine was set at 28 percent, while the [right] engine remained at flight idle.” At this point, the aircraft was at 142 knots indicated airspeed (KIAS), and was slowing to the target approach speed of 125 KIAS, the report said.

As the aircraft descended through 1,080 feet (329 meters) radio altitude at (RA) 127 KIAS, “torque on the [left] engine was increased to 60 percent in order to stop airspeed reduction, and to maintain a target approach speed of 125 [KIAS],” the report said. “Initially, the airspeed decreased further to 120 [KIAS], and then increased to 130 [KIAS].”

Schiphol Arrival issued two reports to the crew (at 1443:42 and at 1445:12) that the surface winds were 280 at eight KIAS, and 280 at nine KIAS, respectively. “At [1444:05], on the request of the captain, the FO stated that the tailwind component was eight [KIAS],” the report said.

At 1444:38, the aircraft was descending through 880 feet (268 meters) RA with the autopilot engaged, and the FO remarked, “The trim is all the way to the left,” the report said. “He [the FO] suggested to the captain to set the rudder trim to neutral just before landing, to which suggestion the captain responded with, ‘Yes, that will make it easier ... ,’” the report said.

When descending through 500 feet (152 meters), “landing clearance was confirmed by both pilots and, shortly thereafter, torque on the [left] engine was reduced to 45 percent and airspeed was maintained at approximately 128 [KIAS] until —passing 300 feet [91.5 meters] RA — torque on the [left] engine was further reduced to 30 percent in order to obtain his final approach speed of 119 [KIAS],” the report said. “At that time, the aircraft was approximately 0.6 dots below the glidepath, and pitch was increased to correct the vertical flight path of the aircraft.”

The airspeed decreased to 120 KIAS as the aircraft descended through 230 feet (70 meters) RA. The FO told the captain that he would move the rudder trim to neutral, to which the captain agreed, the report said. At this point, the aircraft was on the glideslope. “Shortly thereafter, the pitch of the aircraft was decreased, and consequently the aircraft became 0.4 dots below the glideslope,” the report said. The pitch was increased to return to the glideslope, and the left engine torque was increased from 30 percent to 40 percent. “In the meantime, the airspeed had decayed to 115 [KIAS] and, at [1445:41], the FO stated, ‘Mind your speed,’” the report said.

At 120 feet (36.6 meters) RA, “an aggressive increase in torque (from 40 percent to 65 percent) was applied, but hardly any additional rudder input was given to correct for asymmetry,” the report said. “After correcting the initial small rolling movement to the right, the aircraft was kept wings-level by significant aileron input. The aircraft veered approximately six degrees to the right and while passing 90 feet [27.5 meters] RA, just before the landing threshold, the aircraft positioned itself to the right of the extended centerline.

At [1445:46], torque was reduced from 65 percent to 40 percent, which further reduced the airspeed to 110 [KIAS],” the report said.

Shortly thereafter, the captain commanded, “Going around, set torque, flaps seven, gear up,” the report said. The left engine torque was then set at 98 percent, while the right engine remained at flight idle. Seconds later, the flaps were at seven degrees, and the landing gear was fully retracted, the report said.

As the left-engine torque increased, “no additional rudder deflection was applied, but again the initial roll to the right and the additional asymmetry were counteracted by significant aileron input, up to the maximum control-wheel deflection,” the report said. The aircraft pitch initially increased from approximately four degrees to seven degrees, then increased to 12 degrees. “At that time, the airspeed had decreased to 105 [KIAS], and the sudden increase in pitch and associated increase in angle-of-attack triggered the stall warning,” the report said. The pitch was then lowered to six degrees, and the stall warning stopped.

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***“The FO mentioned to the captain, ‘Because you are flying flight idle, you probably have less problems than you might have had otherwise.’”***

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The airspeed decreased to 97 KIAS, and “the aircraft started a shallow turn to the right, with a progressively increasing bank angle,” the report said. “At [1445:58], some additional rudder deflection was applied, but full rudder deflection was only reached at [1446:06].”

The aircraft pitch increased to nine degrees, and the stall warning triggered again at 100 KIAS. “The stall warning remained activated until the moment of impact,” the report said. “During the last few seconds of the flight, the aircraft banked further to the right and airspeed decreased to less than 93 [KIAS].”

The aircraft hit the ground in a slightly nose-low attitude, and in a right bank of approximately 80 degrees, the report said. The crash occurred “in very wet and agricultural terrain, consisting of greasy clay,” the report said.

During the crash sequence, “the right wing was torn off the aircraft upon impact and disintegrated,” the report said. “The fuel from the tank of this wing ignited immediately. The fuselage and the left wing remained connected to each other when they were forced away from the ignited fuel. Although [the tank was] severely damaged, no fuel was leaking from the tank in the [left] wing. The main fire (from the disintegrated right wing) burned out after a few seconds, and only some small flames remained visible at the debris of the right wing, spread around the main parts of the aircraft,” the report said.

The report further described the crash sequence: “The [right] side of the cockpit, and the [right] side of the forward part of the cabin hit the ground and were damaged. ... The aircraft yawed to the right, and the fuselage rolled over onto the [left] wing, pivoting around the [left] wing attachments. ... The aircraft came to rest after having turned approximately 100 degrees to the right from the impact direction, with the fuselage lying on its left side on the left wing, blocking the two [left] exits. The total length of the wreckage trail was 110 meters [363 feet].”

The wreckage ultimately came to rest approximately 1,848 feet (560 meters) right of the runway centerline, and 3,712 feet (1,125 meters) beyond the threshold of Runway 6, the report said.

Firefighting and other rescue equipment had already been positioned alongside the runway, and were only 1,650 feet (500 meters) from where the crash occurred. As a result, rescuers “arrived at the scene of the accident about one minute after the crash took place,” the report said. “The terrain condition of the accident site was wet and muddy.” As a result, “rescue vehicles were unable to enter the terrain,” the report said. “A nearby farmer and his family assisted in the transportation of the injured occupants with a tractor-drawn trailer.”

When rescuers arrived at the main wreckage, they found that the passage between the cockpit and the cabin was obstructed. “Evacuation/rescue of the pilots had to be conducted through the [cockpit] overhead escape hatch,” the report said.

The captain’s side of the cockpit was relatively undamaged. “Investigation of the cockpit interior revealed a badly damaged pedestal with broken handles of both throttles and condition levers,” the report said. “The postmortem medical examination of the captain and the damage observations in the cockpit both revealed that the captain was not wearing his shoulder harness, and that he most probably was smashed against the handles on the pedestal.”

The FO’s side of the cockpit was extensively damaged, and he suffered severe injuries as a result, the report said, adding that “the screwdrive adjustment of the FO’s backrest had been driven past its limit [as a result of the deformation of the right cockpit sidewall], with the consequence that the retaining function of the shoulder straps was lost.”

The aircraft was lying on its left side, which prevented the use of the main passenger door and the left emergency overwing exit for evacuation of the cabin occupants. “The [right] overwing exit was difficult to use, being ‘overhead’ at that time,” the report said. “Rescuers cut through the already deformed [right] side of the fuselage, between the forward exit and the overwing exit, in order to be able to extricate the occupants.”

The cabin attendant had been seated on the left forward side of the aircraft, facing aft. “His seat was found in good condition,” the report said. “The [cabin attendant] suffered only minor injuries, most of them caused by debris of the [right] galley area, which disintegrated upon impact.”

In reviewing the passengers’ injuries, the report said: “Most of the [passengers with minor injuries] or uninjured passengers were seated on the [right] side of the cabin. The serious[ly] injured passengers were seated on the [left] side of the cabin. Injuries varied from broken legs and arms, to cuts and bruises, pelvis fractures and brain concussions. Of the wounded passengers, eight were seriously injured, and 11 suffered only minor injuries.”

The report added: “The two deceased passengers were seated at 3C and 4C, which were located close to the impact point of the crash. Both passengers died instantly, or very shortly after the accident, due to severe traumatic injuries.”

The aircraft was destroyed, the report said.

The background and qualifications of the flight crew were reviewed. The captain, age 37, held a Netherlands senior commercial pilot’s license, with instrument rating, and an

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***The aircraft hit the ground in a slightly nose-low attitude, and in a right bank of approximately 80 degrees.***

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aircraft rating for the Saab 340B. He had 2,605 hours total flying time, and 1,214 hours in the Saab 340B, the report said.

In reviewing the captain's medical history, the report said: "While exercising the privileges of his license, the captain had to wear correcting glasses. No other restrictions applied to the license of the captain. At the time of the accident, the captain was wearing contact lenses."

The captain was hired by KLM Cityhopper in 1992. A review of the captain's training history revealed that he experienced problems during type training. The captain had failed the initial Saab 340B type-rating examination in both the simulator and the aircraft itself, the report said. After additional training and re-examination, he passed the type-rating, and started flying as an FO.

Seven months later, during a simulator proficiency check, his performance "was assessed as proficient, [but] remarks indicated that he again experienced [the same] problems [as before] and had been assessed 'standard minus' on this subject," the report said. During captain's training, no further problems occurred, and he was promoted to captain in 1993.

The captain's duty and rest times were reviewed. On the day of the accident, the captain flew one flight prior to the accident flight, the report said. The day before the accident, the captain had been on reserve status, but did not fly. On the three days previous to his reserve status, the captain had been off duty. "During the previous three months, the captain had flown seven flights from Amsterdam to Cardiff," the report said.

The FO, age 34, held a Netherlands commercial pilot's license, with instrument rating, and aircraft ratings for the Piper PA-31 and the Saab 340B. He had 1,718 hours total flying time, and 1,334 hours in the Saab 340B. A review of the FO's medical history showed that "there were no restrictions imposed on the license of the FO," the report said. The FO was hired by KLM Cityhopper in 1992.

On the day of the accident, the FO flew with the captain on the same flight prior to the accident flight. The day before the accident flight, the FO was on duty from 0615 to 1340, and flew two flights, the report said. The FO had been off duty the previous two days.

Although surviving the crash, "as a result of the impact forces, the FO suffered from amnesia," the report said. "Therefore, he was not able to give any useful information regarding the accident flight."

Investigators reviewed the weight-and-balance for the accident flight, and found both to be within limits, the report said. The

accident aircraft was equipped with a Fairchild CVR and a Sundstrand universal flight data recorder (UFDR). "Data recorded by the CVR were of good quality," the report said. "The data recorded on the UFDR were of excellent quality."

When investigators examined the wreckage, "all aircraft parts and control surfaces were accounted for at the accident site," the report said. "The aircraft damage was consistent with the exposure to the excessive loads during the impact sequence, and the effects of the subsequent fire. No pre-existing defects likely to have contributed to the accident were found," the report said.

The flight control systems were examined, and "there was no indication of any malfunction in these systems," the report said. "Some of the [cockpit] flight instruments sustained severe impact damage to such a degree that testing was not possible," the report said. "Given the flight recorder and CVR registrations, together with the flight crew's actions, the [Netherlands Aviation Safety] Board is of the opinion that the captain's instruments were working correctly."

The engines and propellers were examined, and no pre-impact damage or malfunction was found. When the oil-pressure and temperature instruments and transducers of both engines were tested, "the [right-]engine oil-pressure switch was found to have failed internally," the report said. "The switch was shorted, resulting in intermittent illumination of the oil low-pressure light. All other tested instruments and transducers functioned correctly, with some minor tolerance exceedances, most probably due to impact forces."

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The report concluded: "The [right-]engine oil-pressure CWP light illuminated as a result of a short circuit in the oil-pressure switch. This short circuit closed the switch and, as a consequence, the oil-pressure warning light on the CWP was activated. The [right-]engine oil-pressure transducer was found operating normal[ly], and it must be concluded that the actual engine oil pressure was correctly presented on the [right-]engine oil-pressure indicator in the cockpit."

Investigators analyzed the flight crew's handling of the oil-pressure warning. When the master warning first sounded, the FO announced, "Right-engine oil pressure," to which the captain responded, "Check," the report said. "The captain then slowly retarded the [right] power lever to the flight idle position," the report said. "Retarding the power lever does not form part of the ECL procedure. Possibly this was done with the intention to prevent damage to the [right] engine. As a result of this action, the oil pressure of the [right] engine decreased, which is normal when a large power reduction is applied."

The report continued: "Both pilots concluded that the [right-]engine oil pressure was lower than the [left-]engine oil

## Translation of relevant part of CVR transcript from KL433

**14:30:58 CAPT.:** Take action.

**14:31:00 FO:** Take action. Emergency checklist. Engine and propeller, engine oil-pressure low ... 15B.

**14:31:16 FO:** 15B ... engine oil-pressure low, engine oil and prop oil pressure ... checked. Well, engine oil pressure uh ... that is this one, this one is slightly lower than the other one, but ...

**14:31:32 FO:** It is decreasing.

**14:31:33 CAPT.:** Yes.

**14:31:34 FO:** Yes, it is decreasing.

**14:31:37 FO:** If only prop oil pressure, apply uh ... uh ... if only prop oil pressure low, apply propeller oil-pressure low procedure, well ... that is not the case.

**14:31:43 FO:** Then next ... engine oil-pressure control warning panel light on ... or, engine oil pressure below 30 PSI.

**14:31:54 CAPT.:** That is not the case.

**14:31:57 CAPT.:** But it is still normally in the green, that is what's so strange.

**14:31:59 FO:** That's funny, isn't it?

**14:32:00 CAPT.:** Yes.

**14:32:01 FO:** It is decreasing uh ... [captain's first name] engine oil-pressure light on, or ...

**14:32:12 CAPT.:** Yes, but we are not going to continue with this ...

**14:32:13 FO:** No, no, no, no, no, engine oil pressure ... , well light or below 30 PSI, that is not the case. So, one of two things ... If so, then you may continue, but if they are both on, so if the light is on and the pressure is below 30 PSI, then it must be shut down.

**14:32:33 CAPT.:** Okay.

**14:32:37 CAPT.:** Well, what do we have? Is it an ... above 50?

**14:32:41 FO:** Yes.

**14:32:42 CAPT.:** And we ... [set] the warning pressure is ...

**14:32:43 FO:** Yes, the light is on. So the light is on, or below 30, well ...

**14:32:50 CAPT.:** Continue normal operation.

**14:32:51 FO:** Yes.

pressure and, furthermore, that the [right-]engine oil pressure was decreasing. Neither pilot realized that the lower and still decreasing [right-]engine oil pressure was most probably a result of the retardation of the [right] power lever, still continuing at this stage. The FO continued with the engine oil-pressure low procedure in the ECL.”

The report noted: “The redundancy in the engine-oil low-pressure indication system is to prevent a situation where an incorrect indication by the warning light or an incorrect indication of the pressure indicator could lead to the wrong conclusion. Flight crew action indicates that both pilots did not understand the system logic.”

Although both pilots concluded that normal operations could be continued, the captain continued with the right engine in flight idle. “If the flight crew ... had any serious doubts about the condition of the [right] engine, they should have carried out the engine shutdown procedure, followed by the OEI [One Engine Inoperative] Checklist,” the report said. “The decision by the captain not to use the [right] engine at this stage of the flight may have been influenced by his prior experience as FO with an emergency resulting in a return to and landing at Amsterdam under similar conditions.”

The flight crew flew the approach into Amsterdam with the right engine at flight idle, but did not fly the airspeeds required for a single-engine approach, the report said. The cockpit conversations indicated that the flight crew believed they would have less difficulty handling the aircraft with the right engine in flight idle. They appeared to compare this condition with having the engine shut down and the propeller feathered. The report concluded: “Both pilots were not aware of the consequences related to making an approach with one engine in flight idle.”

The captain's decision to land with a tailwind component was reviewed. “By his choice of Runway 6, the captain accepted a tailwind component which, though within limits and acceptable under normal conditions, is not recommendable in a single-engine situation, as it aggravates the speed stabilization problem,” the report said.

The tailwind component during the descent of KL433 placed the aircraft too high for a straight-in approach, and an S-turn was required to position the aircraft on the ILS, the report said. The aircraft's high position also resulted in a descent with both engines at flight idle. When power was applied on the left engine, “the pilots had little time to become accustomed to the unusual flight condition with high asymmetric drag,” the report said.

The report commented on the captain's improper rudder control during the approach: “As long as the autopilot was engaged, automatic rudder trim was used to compensate for asymmetric power. However, the rudder trim is inherently slow, and does not compensate immediately for fast power changes. The

UFDR shows that the captain applied little or no rudder to compensate for the lagging trim. Instead, he corrected the resulting roll exclusively with ailerons.”

The report concluded: “Throughout the entire approach, the aircraft never stabilized in power, airspeed and pitch, which in all probability was caused by a lack of awareness of the captain with the existing situation, i.e., one engine in flight idle instead of feathered, with consequently a higher drag and higher asymmetrical forces.”

Performance calculations by investigators showed that a go-around was possible. With the flaps set at seven degrees, and the landing gear retracted, the aircraft should have climbed at a 2.3-percent gradient, the report said. “When the go-around was initiated, the actual speed (110 [KIAS]) was higher than the minimum control speed [ $V_{mc}$ ] (103 [KIAS]), and with the proper flight technique, the aircraft could have been kept under control,” the report said.

When the captain started losing control during the go-around, “the only viable option for the flight crew at this stage would have been a power increase on the [right] engine,” the report said.

The report also cited examples of poor crew resource management (CRM) skills during the accident flight. When the captain continued the flight with the right engine in flight idle, “the flight crew did not thoroughly discuss the consequences of the aircraft configuration for the remainder of the flight, nor did they consult the AOM [aircraft operations manual]/dispatch deficiency guide,” the report said.

The report added: “According to a statement of the chief instructor of the Saab 340 division, he and the captain (at that time FO) had experienced a similar situation (engine oil-pressure low warning) during which the situation was thoroughly discussed, and then the decision was made to use both engines in case of a go-around.”

The report concluded: “By not taking into account the configuration of the aircraft and the environmental factors, the captain did not show good situational awareness. The lack of explicit and effective communication between the captain and the FO contributed to this lack of situational awareness.”

The report also noted: “The FO communicated most of the time in a nonassertive way. His statements and remarks showed at times good insight, but were mainly presented as suggestions, not challenging the captain to behave in a more proactive way.”

The captain had attended an introductory course on CRM, and the FO was scheduled for it. KLM Cityhopper (KLC) flight instructors and the head of KLC flight operations told investigators that “the captain had sufficient knowledge and

experience to be able to handle [such] an emergency as [the one that] occurred,” the report said.

As a result of its investigation, the Netherlands Aviation Safety Board concluded the following:

- “The flight crew was licensed, qualified and certified to operate the aircraft;
- “Meteorological conditions were in [themselves] not a factor in this accident;
- “Prior to the flight, the aircraft was fully serviceable. Weight-and-balance were within limits;
- “During climb, the [right]-engine oil-pressure switch failed, resulting in aural and visual warnings in the cockpit;
- “In reaction to the oil-pressure warning, the captain slowly retarded the right-hand power lever to flight idle;
- “The flight crew did not realize that the decrease of the [right]-engine oil pressure was the result of the power reduction. Although the oil pressure remained within normal operating limits they — contrary to ECL procedures — kept the [right] engine running in flight idle;
- “The captain did not realize the consequences of flying with one engine in flight idle, and was not able to anticipate correctly ... the airspeed variations which resulted in an approach not stabilized in power, airspeed and pitch during the final approach. [The] situation ... was possibly aggravated by the tailwind component;
- “Neither the manufacturer’s AOM nor the KLC’s AOM of the Saab 340B contains guidance material concerning the consequences of an engine in flight idle;
- “While actually using only one engine, the return flight and approach were executed using all engine-operative procedures;
- “Incorrect use of rudder resulted in a displacement of the aircraft to a position right of the runway, from which a landing was not feasible, and a go-around was initiated;
- “During the go-around, inadequate use of the flight controls by the captain resulted in loss of control;
- “Crew resource management during the flight was virtually nonexistent;
- “Performance calculations showed that under the prevailing circumstances, with one engine in flight idle, using proper flight techniques, a go-around could have been made;

- “Except for the failed engine oil-pressure switch, there was no evidence of any other failure or defect on the aircraft, including engines and systems;
- “The accident can be classified as generally survivable. Failure to utilize available restraint provisions (shoulder straps) in the cockpit resulted in a fatal injury;
- “The concept of KLC’s pilot selection and training is above legal requirements;
- “Several procedures in the KLC AOM/ECL for the Saab 340B were either unclear or not complete: engine and prop oil-pressure procedure; determination of approach speeds; neutralizing of rudder trim during one engine–inoperative approach/landing phase; [and,]
- “ATC, fire-fighting and rescue services handled the emergency and the accident in a proficient way. The fact that ... fire-fighting and rescue vehicles did not traverse nonstabilized agricultural terrain did not influence the survivability aspects.”

The Netherlands Aviation Safety Board issued the following recommendations as a result of its investigation:

- “Establish ... crew resource management training and integrate CRM into command promotion assessment;
- “Evaluate/improve KLC Saab 340B AOM/ECL information to contain guidance on: use/prohibition of engine flight-idle operation [and] neutralizing rudder trim during one engine–inoperative approach/landing phase;
- “Review the procedure in the KLC AOM on how to determine correct approach speeds; [and,]
- “Evaluate/improve capability of fire-fighting and rescue vehicles to traverse nonstabilized terrain.”♦

Editorial note: This article was adapted from *KLM Cityhopper Flight KL 433, SAAB 340B, PH-KSH, Schiphol, Amsterdam Airport, April 4, 1994*. Aircraft Accident Report 94-05, prepared by the Netherlands Aviation Safety Board. The 50-page report, which was published in October 1995, is in English and includes diagrams and illustrations.

## ACCIDENT PREVENTION

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