Mixed Mode Mishap

Landing was conducted with autopilot off, autothrottles on.

BY MARK LACAGNINA

The following information provides an awareness of problems in the hope that they can be avoided in the future. The information is based on final reports by official investigative authorities on aircraft accidents and incidents.

JETS

No Guidance for Bounced Landing Recovery
Boeing 737-800. Substantial damage. No injuries.

Nighttime visual meteorological conditions (VMC) prevailed, with winds from 260 degrees at 4 kt, when the flight crew conducted a visual approach to Runway 24 at University Park Airport in State College, Pennsylvania, U.S., on Nov. 19, 2005. The captain used the “mixed-mode method of flight control,” said the report by the U.S. National Transportation Safety Board (NTSB) — he disengaged the autopilot about 575 ft above ground level (AGL) but left the autothrottles engaged.

The flight crew said that they used flight management system vertical navigation guidance and the Runway 24 instrument landing system (ILS) as backups for the visual approach. After disengaging the autopilot, the captain observed that the airplane was “a little low” with reference to the ILS glideslope and increased the 737’s pitch attitude. The autothrottle system commanded a thrust increase when airspeed decreased below 143 kt, the value selected on the mode control panel.

Nearing the runway, the captain observed that the airplane was “a little high” with reference to the precision approach path indicator (PAPI) lights. He disengaged the autothrottle system but did not move the throttle levers to idle when he began the landing flare about 30 ft AGL. Ground-speed was 132 kt when the airplane touched down on the 6,700-ft (2,042-m) runway.

The airplane bounced and became airborne. The captain moved the throttles to idle, which caused deployment of the speed brakes. He said that he then attempted to reduce the resulting high descent rate by “adding flare.” Pitch attitude was 9.5 degrees nose-up, and peak vertical acceleration was 2.5 g — 2.5 times standard gravitational acceleration — when the 737 touched down again. The tail struck the runway, damaging the tail skid, several fuselage skin panels and some internal structural components. None of the 127 airplane occupants was injured.

The Boeing 737NG Flight Crew Training Manual (FCTM) recommends that, to recover from a bounced landing, the pilot flying should hold or re-establish a normal landing attitude and add thrust as necessary to control the rate of descent. “The FCTM also advises that thrust need not be added for a ‘shallow skip or bounce’; however, if a ‘high, hard bounce’ occurs, the pilot should initiate a go-around,” the report said.

The report noted that two months before the accident, NTSB recommended that the U.S.
Federal Aviation Administration (FAA) require commercial aircraft operators to incorporate bounced landing recovery techniques in their flight manuals and to include the techniques in initial and recurrent pilot training. The recommendation was generated by the investigation of a nonfatal ATR 72 bounced landing accident in San Juan, Puerto Rico, on May 9, 2004. In response to the recommendation, the FAA in June 2006 issued Safety Alert for Operators (SAFO) 06005, recommending that operators revise their manuals and training programs to include bounced landing recovery techniques. “The SAFO was not a requirement,” the report said. “Rather, it was a recommendation.” NTSB subsequently asked the FAA to survey operators to determine how many of them adopted the SAFO recommendations. At press time, the FAA had not responded to the request.

The report also noted that, in a 1996 FAA document titled *The Interfaces Between Flightcrews and Modern Flight Deck Systems*, a human factors (HF) team said that possible hazards of mixed-mode flight control operations include unintended mode or airplane configuration changes, inappropriate pitch or thrust applications and masking of flight path or energy trends (*Flight Safety Digest*, 9–10/1996). “Some operators [surveyed by the team] stated they expressly discouraged mixed-mode flying on some airplane types, while others generally encouraged its use as a means to retain manual skills proficiency while minimizing workload,” the report said. “As a result of the study, the HF team recommended that the FAA require operator manuals and initial/recurrent qualification programs to provide clear and concise examples of circumstances in which the autopilot should be engaged, disengaged or used in a mode with greater or lesser authority … and appropriate combinations of automatic and manual flight path control — for example, autothrottles engaged with the autopilot off.”

The 737 FCTM recommends that, except during takeoff and climb, the autothrottles be used only when the autopilot is engaged. The report said that the accident airplane operator’s manuals contained no prohibition against mixed-mode operations or guidance for bounced landing recovery.

Based on the findings of the investigation, NTSB said that contributing factors were “the operator’s failure to provide sufficient information on the use of autothrottles and bounced landing recovery techniques, along with the [FAA’s] failure to require the inclusion of mixed-mode flight control guidance and bounced landing recovery techniques in operator pilot training programs and flight manuals.” The probable cause of the accident was “the pilot’s improper touchdown and recovery from a bounced landing,” NTSB said.

**Parking Brake Engaged on Approach**

Airbus A319-100. Substantial damage. No injuries.

The first officer was the pilot flying the scheduled flight from London to Leeds–Bradford (England) Airport on Jan. 24, 2007. The airplane entered a snow shower when it descended below the clouds about 3,000 ft AGL during the approach to Runway 32. Winds were reported from 010 degrees at 14 kt, variable from 340 degrees to 050 degrees. However, weather conditions at the airport were changing, and air traffic control (ATC) issued five wind reports to the crew, said the report by the U.K. Air Accidents Investigation Branch (AAIB).

The report said that the commander likely focused his attention on the wind reports during the approach. “The commander stated that he had been involved in a previous landing at Leeds–Bradford in difficult wind conditions, which resulted in the use of a significant portion of the runway length, due to a tail wind,” the report said.

The A319 was descending through 1,300 ft when the first officer called for full flaps. “Coincidently, ATC transmitted a further wind check, and this was acknowledged by the commander,” the report said. Meanwhile, the captain engaged the parking brake, instead of selecting full flaps. “The parking brake handle and flap selection lever are located on the aft section of the center pedestal,” the report said. “The flap lever is moved fore and aft through the various flap position ‘gates,’ while the parking brake is selected
by grasping the parking brake handle and rotating it clockwise. Despite these controls being of different shapes, requiring different methods of activation, their shapes allow both to be grasped in a similar manner prior to selection.”

The report noted that the airplane’s flight warning computer (FWC) was an earlier model that displays an amber “PARK BRK” indication on the electronic centralized aircraft monitor (ECAM) when the parking brake is engaged in flight. Later-model A319 FWCs also trigger the master caution light and an aural tone, and display a checklist item on the ECAM that advises the crew to disengage the parking brake.

A few seconds after calling for full flaps, the first officer noticed that the “FLAP 3” setting was still selected. He repeated the request, and the commander selected full flaps. Neither pilot noticed the “PARK BRK” indication on the ECAM.

“Immediately after touchdown, the flight crew noted that the brakes appeared to take effect immediately with a greater deceleration than usual,” the report said. “After coming to a halt, the commander requested the first officer to apply the parking brake, but the first officer found it already set.”

The crew thought that one tire on the main landing gear had deflated during the landing. However, aircraft rescue and fire fighting (ARFF) personnel notified the crew that all four main landing gear tires had deflated. The 53 passengers disembarked and were taken to the terminal by bus.

Wing Strikes Runway on Landing
Cessna Citation 560. Substantial damage. No injuries.

Five passengers were aboard the airplane for a charter flight from Chicago to Lakeland Airport near Woodruff, Wisconsin, U.S., the morning of Jan. 5, 2006. The airport was reporting 10 mi (16 km) visibility, a 1,300-ft overcast and winds from 350 degrees at 14 kt, gusting to 21 kt. The flight crew calculated a landing reference speed, Vref, of 101 kt, and the captain flew the localizer approach to Runway 36 at 110 kt, the NTSB report said.

The Citation encountered light rime icing conditions while descending from 4,500 ft to 2,600 ft, and the crew activated the deicing boots three times. According to the report, the airplane operating manual (AOM) says that small amounts of ice normally form on unprotected areas of the airplane and can cause about a 5-kt increase in stall speed. The AOM advises that approach speeds and landing reference speeds should be adjusted accordingly.

After descending below the clouds about 1,000 ft AGL, the captain used the PAPI for visual descent guidance to the runway. “At approximately 50 feet, the captain brought the power levers to idle,” the report said. “All seemed normal until [the Citation was] approximately 20 to 30 feet [AGL], when the aircraft felt as if it lost lift, and the right wing dropped.”

The first officer said that airspeed decreased 4 or 5 kt below Vref when the Citation was about 20 ft AGL. The captain said that he increased power when the stick-shaker — stall warning — activated and attempted to level the wings. However, the right wing tip struck the runway when the airplane touched down. The airplane bounced, turned slightly right, touched down off the right side of the runway and struck a snow bank.

NTSB said that the probable cause of the accident was “the captain’s failure to maintain adequate airspeed during the landing, which resulted in a stall/mush.”

Brake Warning Caused by Broken Wheel Hub
Boeing 767-300. Substantial damage. No injuries.

The “BRAKE TEMP” warning light illuminated during takeoff from London Heathrow Airport on March 3, 2007, and the flight crew saw indications that the no. 1 wheel brake was hot and getting hotter, the AAIB report said. Airspeed was between 90 and 100 kt when the crew rejected the takeoff. After slowing to taxi speed, they turned the 767 off the runway.

Brake temperature continued to increase rapidly, and the crew requested ARFF services. ARFF personnel saw that the no. 1 wheel was severely damaged. “Although there was no fire, the
The airplane was on a cargo flight from Umeå, Sweden, to Luleå–Kallax Airport the night of Oct. 13, 2006. The destination airport was reporting winds from 320 degrees at 4 kt, runway visual range (RVR) 550 m (1,800 ft) and vertical visibility 100 ft in fog. The RVR was at the minimum for the ILS approach to Runway 32, said the report by the Swedish Accident Investigation Board (SHK).

Runway 32 was 3,450 m (11,319 ft) long and 45 m (148 ft) wide. It had a painted runway centerline but no centerline lights. The report said that the edge lights were 4 m (13 ft) from the runway edges despite Swedish civil aviation regulations that require edge lights to be displaced no more than 3 m (10 ft).

The copilot flew the approach with the autopilot engaged. Both pilots said that although the power levers were in the same position, the engine instruments showed indications of asymmetric power. Recorded flight data showed that the right engine was producing more power than the left engine. Among the recorded torque values were 50.2 and 28.0, respectively, at 50 ft radar altitude and 17.0 and 4.2 on touchdown.

The pilots saw the approach lights about 200 ft AGL, and the copilot disengaged the autopilot. The report said that when the copilot reduced power to flight idle about 50 ft AGL, he likely did not reduce right rudder control pressure that had been applied to counter the asymmetric thrust; as a result, the airplane yawed right and touched down near the right side of the runway. "Rudder control was applied, but the aircraft..."
went out to the edge of the runway before it could be steered back to the center of the runway,” the report said.

After parking the airplane, the crew found that one of the tires on the right main landing gear had been damaged when it struck a runway edge light.

SHK said that the incident was caused by the crew’s “failure to maintain the correct heading during landing, probably caused by the differential power from the engines, combined with the limited experience of the pilots [in] this type of aircraft.” The crew had been flying the ATP about three months. The commander had 3,495 flight hours, including 124 flight hours in type. The copilot, the pilot flying, had 1,861 hours, including 109 flight hours in type.

The board said that contributing factors were the absence of runway centerline lighting and the displacement of the runway edge lights.

**Ice Ingestion Suspected in Power Loss**
Jetstream 41. No damage. No injuries.

The airplane was en route from Leeds–Bradford (England) Airport to Southampton with 17 passengers the morning of Jan. 11, 2007. In adherence with the manufacturer’s recommendations and the company’s standard operating procedures for flight in potential icing conditions, the flight crew operated the engine anti-icing and continuous ignition systems throughout the flight, the AAIB report said.

The crew also activated the propeller deicing system when the Jetstream encountered light-to-moderate icing conditions during climb and cruise at Flight Level (FL) 190 (about 19,000 ft). “During the flight, the crew occasionally heard ice being shed from the propellers … but airframe ice accretion was not sufficient to require operation of the pneumatic deicing boots,” the report said.

Nearing Southampton, the crew was told by ATC to descend to FL 70 and was given a radar vector to intercept the ILS localizer for Runway 20. As the airplane descended through 7,500 ft, the right engine lost power. “Some 62 seconds later, the right engine began an auto-restart as a result of the operation of the continuous ignition system, following which, both engines ran normally,” the report said. The airplane was landed without further incident.

Examination of the airplane revealed no technical defects that could have caused the power loss. The report said that it might have been caused by ice that accumulated above the heated upper lip of the right engine’s air intake and then entered the intake when the airplane descended into warmer air.

Investigators were unable to determine why the continuous ignition system did not restart the engine within five seconds, as designed, “or why, given that both engines were likely to have experienced exactly the same environmental conditions, only the right engine was affected,” the report said. “The possibility that the right engine was predisposed to flameout in the ‘right’ conditions — due to, for example, the condition of the igniters or fuel nozzles — could not be dismissed.”

The report said that modified engine air intakes developed by the manufacturer to further reduce the risk of ice ingestion had not been installed — and were not required to be installed — on the airplane.

**Pilot Continues Landing Over Snowplow**
Beech Super King Air 200. Substantial damage. No injuries.

The pilot was conducting a positioning flight from Oklahoma City to Angel Fire (New Mexico, U.S.) Airport, which was reporting 7 mi (11 km) visibility in light snow and a broken ceiling at 1,900 ft the morning of March 24, 2007. The pilot said that he announced his position three times on the common traffic advisory frequency while conducting an area navigation approach to Runway 17, which is 8,900 ft (2,713 m) long and 100 ft (30 m) wide.

The King Air was about 2 nm (4 km) from the airport when the pilot saw a snowplow near the approach end of the runway. He maneuvered the airplane to avoid flying over the snowplow and touched down about 1,000 ft (305 m) from it. “Pictures of the accident airplane and runway environment, taken immediately after the accident, depict a swath of unplowed snow in the middle of the runway,” the NTSB report said. “During the landing roll, the left wing contacted the swath of
snow. The airplane yawed about 25 degrees left and departed the runway environment.” Damage included a collapsed nose landing gear.

The report said that no notices to airmen (NOTAMs) had been issued for runway conditions or the snow-removal operations at the airport. The snowplow operator said that he was carrying a hand-held radio but did not hear the pilot’s position reports.

NTSB said that the probable cause of the accident was “the pilot’s inability to maintain clearance from the snow bank.” Contributing factors included “the pilot’s failure to perform a go-around/missed approach procedure after observing snow-removal equipment on the runway [and] the lack of NOTAMs for runway conditions.”

PISTON AIRPLANES

Procedures Omitted After Engine Failure

Cessna 414A. Destroyed. Three fatalities.

Daytime VMC prevailed for the air ambulance positioning flight from Honolulu to pick up a patient in Kahului, Maui, Hawaii, U.S., on March 8, 2006. The airplane was about 2 nm (4 km) from Runway 02 at Kahului Airport when the pilot told ATC, “We lost an engine. We need assistance.”

Investigators determined that the left engine had failed but were unable to determine why it failed. The pilot did not feather the propeller or retract the landing gear and flaps. The 414 stalled, rolled right, descended rapidly into an automobile dealership and was destroyed by the impact and post-impact fire. The pilot and both flight medical attendants were killed. Ten automobiles were destroyed, but no one on the ground was hurt.

NTSB said that the probable cause of the accident was “the failure of the pilot to execute the published emergency procedures pertaining to configuring the airplane for single-engine flight.”

The report indicated that the pilot — who held airline transport pilot and flight instructor certificates and had about 3,142 flight hours, including 1,519 flight hours in multiengine airplanes — had been involved in a similar accident about eight months earlier.

That accident occurred while the pilot was providing flight instruction to a private pilot in a Piper Apache 160 on July 1, 2005. He had intentionally shut down the left engine and feathered the propeller for instructional purposes but then was unable to restart the engine. The hydraulic pump driven by the left engine normally is used to extend the landing gear. With the left engine inoperative, the pilot attempted to extend the landing gear manually while the student flew the Apache back to Honolulu International Airport.

The July accident report said that the pilot did not conduct the manual or emergency gear-extension procedures correctly. However, a tower controller told the pilot that the landing gear appeared to be fully extended. The pilot took control of the Apache and was about to flare the airplane for landing when someone radioed that the nose gear did not appear to be extended. “The [pilot] then reactively applied power, and the airplane rolled to the left and impacted the ground,” the report said. Neither pilot was injured; the Apache was substantially damaged.

Air in Brake Line Contributes to Overrun

Piper Seneca II. Minor damage. No injuries.

During an instructional flight the evening of March 3, 2007, the airplane was landed about 476 m (1,562 ft) beyond the normal touchdown point on the 1,310-m (4,298-ft) runway at Cork (Ireland) Airport. The instructor, the pilot flying, said that judging the approach and flare had been difficult because of sun glare. When he applied the wheel brakes after touchdown, the left toe-brake pedal “went full down” and the right main wheel locked, causing the tire to skid, said the report by the Irish Air Accident Investigation Unit.

“The resulting asymmetric braking made directional control difficult,” the report said. Because of this, and because he believed enough runway remained to stop the aircraft, the instructor decided not to conduct a go-around.

The student pilot then applied hard wheel braking, locking both main wheels and deflating the tires. With no effective braking remaining, the Seneca overran the runway at 40 kt and
The airplane was being flown on Dec. 14, 2006, for the first time following completion of an annual inspection in Montgomery, New York, U.S. Witnesses said that pitch oscillations occurred on initial climb before the 310 turned left, descended and crashed in a wooded area.

The elevator trim tab was found in the full, 10-degree, nose-down position. The NTSB report said that further examination revealed that the elevator trim cables had been reinstalled incorrectly after replacement of the trim actuator during the annual inspection.

NTSB said that the probable causes of the accident were “improper maintenance performed on the airplane by maintenance personnel and the failure of the mechanic with an inspection authorization to verify the maintenance work performed, which resulted in a reversed elevator trim system and subsequent loss of control.”

**HELICOPTERS**

**Winds, Weight Reduce Climb Performance**
Bell 212. Substantial damage. Twelve minor injuries.

The helicopter was near maximum gross weight after boarding 11 people who had skied down Spearhead Glacier near Whistler, British Columbia, Canada, on Feb. 11, 2005. Elevation of the area was 6,300 ft, and the pilot took off into 30-kt, gusting winds and toward the face of the glacier, said the report by the Transportation Safety Board of Canada.

After attaining a positive rate of climb, the pilot turned the helicopter downwind. “It began to descend, and it was evident that the helicopter would not clear the lower ridge,” the report said. “The pilot turned the helicopter toward a somewhat level area. As it contacted the snow, the helicopter bounced, struck a snowdrift, dug in, stood on its nose, pirouetted and came to rest on its right side.”

The main rotor blades severed the tail boom. There was no fire. The report noted that stainless steel elbow fittings, installed on the helicopter’s fuel lines in accordance with Airworthiness Directive CF-97-04, remained intact in an area that was crushed during the accident.

“The evacuation from the wrecked helicopter was carried out in a calm manner,” said the report, which noted that the passengers remembered instructions they had received during interactive emergency training before the first flight of the day.

**Engine Fails Over Dense Forest**
Eurocopter AS 350BA. Destroyed. One serious injury, four minor injuries.

The pilot was conducting a sightseeing flight over a dense tropical forest in Hana, Maui, Hawaii, the morning of Jan. 10, 2006, when the helicopter began to vibrate, and the low-rotor-rpm warning horn sounded. “The pilot entered an autorotation and tried to arrest the helicopter’s forward velocity before settling into the treetops [on a steep slope],” the NTSB report said.

“The helicopter dropped nose-first toward the forest floor and came to rest on its right side, suspended in the trees a few feet from the ground. The four passengers and the pilot [who was seriously injured] were able to lower themselves to the ground.” They used a cell phone to call for assistance.

Examination of the Turbomeca Arriel 1B engine revealed that a second-stage turbine blade had separated as a result of a fatigue fracture initiated at a corrosion pit. The engine had been operated 9,593 hours, including 1,764 hours since its last overhaul. “As a result of the investigation into the engine failure, the engine manufacturer has reduced the life limit of the second-stage turbine blades from 6,000 hours to 3,000 hours and implemented additional turbine-inspection criteria,” the report said.
### Preliminary Reports

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<td>Oct. 28, 2007</td>
<td>Katowice, Poland</td>
<td>Boeing 737</td>
<td>substantial</td>
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The airplane crashed in a residential area after an engine failed on takeoff. The fatalities included 28 people on the ground.

The air ambulance was descending in nighttime visual meteorological conditions (VMC) during a positioning flight when it struck terrain at 11,900 ft.

Radar data indicated that the Caravan entered a rapid descent from 13,000 ft and struck mountainous terrain at about 4,300 ft. The airplane was returning to Shelton, Washington, after a skydiving event in Star, Idaho.

Nighttime instrument meteorological conditions (IMC) prevailed when the airplane struck trees and crashed on approach.

The airplane was on a scheduled flight from Villavicencio to Uribe when it struck a mountain at about 7,875 ft.

Soon after the captain reported an engine problem during takeoff for an air ambulance flight, the King Air stalled and descended into a residential area. The fatalities included two people on the ground.

The airplane was en route from Hurghada, Egypt, to Warsaw, Poland, when the crew reported an electrical problem and diverted to Istanbul. The landing gear separated when the MD-83 overran the runway.

Nighttime VMC prevailed when the airplane took off from Taxiway M, instead of the assigned Runway 36L, at Memphis International Airport and passed 400–500 ft over a regional jet holding on the taxiway.

During a landing on Runway 18 in heavy rain, the pilot selected reverse thrust just as the wind shifted from southeast to west. Directional control was lost, and the Sabreliner hydroplaned off the left side of the runway.

Witnesses said that they heard a "rough-running" engine when the airplane took off in VMC. The Aero Commander struck a barn and burned about 3 nm (6 km) from the airport.

The crew reported an engine problem during departure for a cargo flight to Singapore and attempted to return to Phnom Penh. The Antonov struck a rice field about 25 km (14 nm) from the airport.

The airplane, which was operated by a police department in England, struck mountainous terrain under unknown circumstances.

The pilot said that after entering IMC about 250 ft above ground level on approach, uncontrolled left and right rolling motions occurred when he attempted to align the airplane with the runway centerline. The left wing struck the runway on touchdown.

During the second landing attempt in IMC, the airplane crashed and burned near the end of the runway.

The A320 landed long in VMC, overran the 6,450-ft (1,966-m) runway and came to a stop in a coconut grove.

The Citation landed hard and overran the runway.

Nighttime IMC prevailed when the 737 struck approach lights while landing.

NA = not available

This information, gathered from various government and media sources, is subject to change as the investigations of the accidents and incidents are completed.