The First Two Minutes

The author reviews problems that have confronted flight crews during the critical takeoff phase and concludes that the accident record would improve considerably if as much attention is paid to the prevention of takeoff emergencies as to the response to them.

by

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Worldwide accident statistics show consistently that most air-carrier accidents occur in the approach and landing phase of flight. In the same statistics, takeoff accidents are next in frequency of occurrence. According to a recent study by Captain Caesar[1], these two phases of operation accounted for 80 percent of the 370 total losses of jet transports in the 1959-1987 period: 57 percent occurred during approach and landing; 23 percent during takeoff.

The predominance of approach and landing (A&L) accidents is confirmed by the fatal jet transport accident experience of U.S. air carriers over the last two decades (1968-1987). Of the 67 fatal accidents in that time frame, 33 (50 percent) were A&L accidents. (See table). The takeoff (T/O) phase took second place with 18 (27 percent) accidents. Of the 3,223 occupant deaths during that period, 1,459 (45 percent) occurred in A&L accidents and 1,151 (36 percent) in T/O accidents.

However, when the U.S. experience is broken down into five-year segments a different pattern emerges. Graphs based on the data in the table show clearly that there was a shift in the phase of flight where most fatal accidents occurred. This is most noticeable in the recent five-year period (1983-1987) when T/O accidents surpassed A&L accidents in terms of frequency of occurrence and occupant deaths: five versus three and 472 versus 138 respectively. During the past 10 years takeoff accidents claimed 69 percent of all occupant deaths.

Considering the growth in traffic volume in the United States since deregulation and the relatively small number of fatal accidents in various phases of flight, no predictive significance can be attached to the data presented here. Nor does it follow that the recent primacy of takeoff accidents in the United States could not have been duplicated elsewhere in the world; it so happens that the U.S. accident data are the most-readily available for analysis — at least to this writer.

Within the limited scope of this discussion it is sufficient to realize that the prominence of takeoff accidents as the greatest loss-producer in the United States during the past five years was brought about by two factors:

- The remarkable decline of A&L accidents over the last 20 years, and
- The gradual increase in T/O accidents over the last 10 years.

The reduction in A&L accidents began with the systematic identification of correctable problems followed by preventive initiatives in several areas: better training and procedures; better ground and airborne equipment; better understanding of weather; implementation of the ground proximity warning system (GPWS); and others.

Based on the industry's success in lowering the accident risk in the A&L phase, it seems reasonable to assume that a similar approach could lower the frequency of takeoff accidents. A logical first step in that regard would be to stimulate system-wide awareness of the problems that already have produced takeoff accidents. This discussion was prepared with that goal in mind; it presents a review of the 18 fatal takeoff accidents involving U.S. operators over the past 20 years. These accidents will be discussed under the following, generalized headings:

Fatal Jet Transport Accidents
U.S. Air Carriers (Part 121) 1968-1987

Graphic not available

Explanatory Notes for Table and Graph:

1. Included are sabotage and turbulence accidents.
2. Excluded are seven single-fatality mishaps; 1971 (1), 1973 (1), 1974 (1), 1978 (1), 1981 (3).
3. Deaths include only the occupants of U.S. operated aircraft.
4. The numbers between brackets express the preceding number as a percentage of all accidents or deaths for that period.

	No. of Accidents	No. of Occupant Deaths
Weather	4	503
Obstruction on runway	4	10
Aircraft configuration	3	160
Engines	2	302
Brakes/tires	2	49
Jammed elevator	1	11
Loss of instruments	1	38
Unknown	1	78
	18	1,151

To avoid the impression that these 18 accidents cover the full spectrum of conditions that can produce takeoff accidents, this review will be expanded with additional case histories under the following headings:

- Selected non-fatal U.S. accidents (page 7); and
- Selected non-U.S. accidents (page 8).

Weather Related Accidents

Boeing 737, 13 January 1982, Washington, D.C. About 75 seconds after the start of the takeoff run from National Airport the aircraft struck one of the Potomac bridges and crashed into the river. Of the 79 occupants, 74 were killed. The weather at the time of the accident was characterized by subfreezing temperatures and moderate-to-heavy snowfall.

The crew did not use engine anti-ice during ground operations or takeoff. As a result, both engine inlet pressure probes became blocked with ice before takeoff. This caused erroneously-high EPR readings which, in turn, resulted in a thrust deficiency of 3,750 pounds per engine when the crew set takeoff thrust by reference to the erroneous EPR gauges. The lower-than-normal thrust setting was aggravated by snow or ice contamination of the airframe. According to the accident report "either condition alone should not have prevented continued flight." It was also noted that the crew "did not add thrust in time to prevent impact."

The first officer was flying. After lift off, the captain gave him several advisories about how to handle the aircraft. There were no indications that the captain assumed control.

The main ingredient in the development of this accident was the crew's apparent unawareness of the effects of engine probe icing on EPR readings. During the investigation it was found that other flight crews had experienced the same phenomenon but without disastrous results. Consequently, these incidents did not draw the attention they deserved.

Boeing 727, 9 July 1982, New Orleans, La. The aircraft crashed into a residential area, about 67 seconds after the start of the takeoff roll, when it encountered a decreasing head windshear of about 38 knots that was associated with a microburst. None of the 145 occupants survived; eight persons on the ground were also killed.

The first officer made the takeoff. According to the accident report, he was not able to arrest the aircraft's sink rate in time to prevent the accident. Twelve seconds after the captain told him "come on back you're sinking", the Ground Proximity Warning System activated; the speed at that time was 149 KIAS. Three seconds later the first impact with trees occurred. The stick shaker speed was 138 KIAS; there was no evidence that the stick shaker was activated. The stall speed was 122 KIAS.

The causal statement, in essence, characterized the accident as an act of God by contributing the cause to the violence of a microburst "the effects of which the pilot would have had difficulty recognizing and reacting to in time. . ." The contributing factor was listed as the inability of current windshear detection technology "to provide definite guidance for controllers and pilots. . ."

DC-8, 12 December 1985, Gander, Newfoundland. This was a military contract flight from Europe to the U.S. During the takeoff following a refueling stop at Gander, the aircraft settled into the trees just beyond the departure end of the runway. The 248 passengers and eight crew members were killed. The following information is based on the findings of the Canadian Aviation Safety Board as reported in aviation periodicals after release of the Board's report on December 8, 1988.

Five of the nine Board members attributed the aircraft's stall at low altitude to ice contamination of the leading edge and upper surface of the wings. Weather conditions were conducive to icing and the aircraft was exposed to freezing and frozen precipitation while on the ground. The aircraft was not deiced. The majority also believed that the effects of aircraft icing could have been aggravated by loss of thrust of the Number Four engine and inappropriate takeoff reference speeds.

Four Board members categorically rejected the majority's findings and believed instead that the accident was caused by an inflight fire that may have resulted from detonations of undetermined origin that led to catastrophic system failures.

DC-9-10, 15 November 1987, Denver, Colo. The aircraft took off in a snowstorm about 27 minutes after it had been deiced. During that time period the aircraft accumulated an unknown amount of contamination on portions of its lifting surfaces. The first officer, who was flying, rotated the aircraft at about twice the normal rate. Shortly after liftoff the aircraft began to roll and the left wing struck the ground. The aircraft broke into three sections. Of the 82 occupants 28 were killed.

The captain had 198 hours of experience in the DC-9 of which 33 were as captain. The first officer had a turbojet experience of 36 hours, all in the DC-9.

The accident was officially attributed to: "The captain's failure to have the aircraft deiced a second time after a delay before takeoff that led to upperwing surface contamination and a loss of control during rapid takeoff rotation by the first officer. Contributing to the accident were the absence of regulatory or management controls governing operations by newly-qualified flight crew members, and the confusion that existed between the flight crew and traffic controllers that led to the delay in departure."

Obstruction On The Runway

Boeing 727, 26 September 1969, New Orleans, La. During a night takeoff the aircraft struck and killed a 9-year old mentally retarded child on the runway. There was no aircraft damage. No further information is available.

Boeing 707, 30 November 1970, Tel Aviv, Israel. During takeoff the aircraft struck a C-97 that was being towed. The Boeing 707 was destroyed; the crew survived. Three persons on the ground were killed. No further information is available.

DC-8, 21 April 1972, San Juan, Puerto Rico. During liftoff, the aircraft struck and killed a man on the runway. There was no aircraft damage. No further information is available.

DC-9-31, 20 December 1972, Chicago, Ill. The DC-9 was taking off with a valid clearance when it struck a Convair 880 that was crossing the runway. The collision occurred at night in a prevailing visibility of 1/4 mile in fog. The DC-9 was destroyed; ten of its occupants were killed. The Convair 880 was substantially damaged.

The presence of the Convair 880 on the active runway was attributed to:

- An ambiguous transmission from the ground controller;
- The controller's non-use of all available information to determine the location of the Convair; and,
- The Convair crew's failure to request clarification of the controller's communications.

Aircraft Configuration

Boeing 707, 26 December 1968, Anchorage, Alaska. This was a cargo flight bound for Tokyo and beyond. The night takeoff from Elmendorf AFB was made with the flaps in the retracted position. The takeoff aural warning system did not function as intended. Shortly after rotation the aircraft began to oscillate laterally and struck the ground in a steep right bank. The crew of three was killed.

The only reference to takeoff flaps was on the taxi portion of the cockpit checklist. Initially, the first officer had lowered the flaps to the takeoff position but the captain had raised them in accordance with company cold weather operating procedures. (There was snow on the ground.) The captain advised the first officer of the flap retraction during a later reading of the taxi checklist. The first officer's comment: "Let's not forget them." This comment was made when the "follow me" truck arrived that was made available by the tower controller because the crew was not familiar with the airport. While the captain was concentrating on controlling the aircraft on the slippery taxiways, the first officer was communicating with Oceanic Control about extending the void time of their clearance. The flight engineer was computing how quickly they could climb to FL350.

That an intensely-occupied crew forgets to re-deploy the flaps in these conditions is understandable. Unfortunately, the takeoff warning system did not alert them to their oversight. In the existing cold weather, the takeoff thrust setting was reached before throttle advancement triggered the switch that armed the system at a 42° throttle angle. Almost two years before this accident, the manufacturer had issued a Service Bulletin recommending a 25° setting for this switch; such a setting would have armed the system down to a temperature of -42°F. Five months after the accident the FAA issued an airworthiness directive that made compliance with the Service Bulletin mandatory.

DC-8-54, 11 January 1983, Detroit, Mich. The crew of the cargo flight took off with a mistrimmed horizontal stabilizer that was still set at the previous landing trim setting of 7.5 units nose up. (The C.G. was 32.5 percent MAC.) Compliance with just one of the six distinct procedural requirements would have ensured a trim setting within acceptable limits. After liftoff the crew was unable to control the pitchup. The aircraft climbed to about 1,000 feet above field elevation, stalled, and crashed within the airport boundaries. The crew was killed.

About 65 seconds before takeoff the first officer and second officer swapped seats with the approval of the captain. The second officer made the takeoff; he was not qualified as a DC-8 first officer.

DC-9-82, 16 August 1987, Detroit, Mich. After an abnormally long takeoff run, the aircraft lifted off the runway as it was accelerating through 168 KIAS. (V_R was 144 KIAS.) The stick shaker activated immediately after liftoff and continued to operate until the aircraft struck the ground, 20 seconds later. Only one of the 155 occupants survived; two persons on the ground were also killed.

It was determined that the crew did not accomplish the taxi checklist in the prescribed manner. As a result, the takeoff was made with the flaps and slats in the retracted position. The airplane's takeoff warning system was designed to alert the crew to such oversights, but it failed to function because the system did not receive electrical power. The reason for the power interruption was not determined.

Engine-Related Accidents

DC-10, 25 May 1979, Chicago, Ill. This was a scheduled passenger flight with 271 persons on board. During rotation the entire Number One pylon and engine separated from the aircraft, went over the top of the wing, and fell to the runway. The crew followed the prescribed emergency procedures which called for a climb-out that was below the stall speed of the left wing; that wing's outboard slats had retracted when hydraulic lines and cables were severed during the engine/pylon separation. The slat disagreement and stall warning system were also disabled. The crew was not in a position to prevent an asymmetrical stall and loss of control. There were no survivors.

The failure of the pylon structure resulted from damage produced by improper maintenance procedures, about eight weeks before the accident.

DC-9-14, 6 September 1985, Milwaukee, Wisc. This was a scheduled passenger flight. The takeoff was made in accordance with reduced thrust and standard noise abatement procedures.

About 17 seconds after rotation the aircraft had reached a height of 450 feet above the ground and accelerated to 168 KIAS. At this point there was an uncontained failure of the high pressure compressor of the right engine. About 1.5 seconds later, the left engine began to lose power for undetermined reasons. Shortly thereafter, compressor stalls induced blade failures in the left engine as the aircraft descended rapidly in an unusual attitude. Elapsed time between liftoff and impact: 33 seconds. None of the 31 occupants survived. The accident occurred in daylight hours; the sky was clear.

The accident was officially attributed to: "The flightcrew's improper use of flight controls in response to the catastrophic failure of the right engine during a critical phase of flight which led to an accelerated stall and loss of control of the airplane. Contributing to the loss of control was a lack of crew coordination in response to the emergency."

The determination that the flight controls were not properly used was based on the investigative conclusion that "the rudder was incorrectly deflected to the right four to five seconds after the right engine failure." It was also found that the catastrophic failure of that engine did not affect the flight control system or the left engine.

Since the DC-9-14 does not require unusual pilot skill to maintain flight after an engine failure on takeoff, this accident seems to defy comprehension. The two pilots had a combined flying experience of more than 10,000 hours. The captain had 1,100 hours in the DC-9-14, including 500 hours as captain. The first officer had 1,600 hours in the DC-9-14, including 1,140 hours as captain; he was also a DC-9 check airman. Such a background is difficult to reconcile with the statement in the accident report that "Both crewmembers were relatively inexperienced in DC-9 flight operations."

Brakes/Tires

DC-8-63, 27 November 1970, Anchorage, Alaska. This was a military contract flight to the Far East, with a crew of 10 and 219 military passengers. The aircraft was 988 pounds below its allowable takeoff weight of 350,000 pounds. The 10,900-foot runway was covered with ice. A light freezing drizzle was falling; the measured cloud base was 300 feet broken; visibility 5 miles. Sunset occurred two hours before the accident.

The aircraft failed to become airborne during the takeoff run and overran the runway. It struck several obstacles, including a 12-foot deep drainage ditch, and came to a stop 3,400 feet beyond the end of the runway.

The impact forces were survivable; 47 persons died in the post-crash fire.

It was determined that none of eight main landing wheels had rotated during the attempted takeoff on the ice-covered runway. (V_R was 153 KIAS; maximum attained speed was 152 KIAS.) Tests showed that the initial sliding coefficient of friction was only slightly higher than the normal rolling coefficient of friction. When the tires failed and the aircraft began to slide on the wheel rims the frictional drag increased.

The source of the pressure in the brake system that locked all eight wheels was not identified. The accident report offers two possibilities: hydraulic/brake system malfunction or inadvertently engaged parking brake.

DC-10, 1 March 1978, Los Angeles, Calif. This was a scheduled passenger flight bound for Honolulu. the takeoff was rejected just before the aircraft reached V_1 speed when the crew heard a loud "metallic bang" and the aircraft began to "quiver". As the aircraft departed the load-bearing surface of the runway, the left main landing gear collapsed and fire erupted in the left wing area. The aircraft slid to a stop about 660 feet from the departure end of the runway. Two of the 200 occupants were killed.

During the takeoff roll three of the tires on the left main landing gear failed sequentially. The shedding of rubber actually began 3,000 feet into the takeoff roll, but the crew did not receive unusual indications until 1.2 seconds before V_1. The aircraft could not be stopped on the available runway because of the wet runway surface and the partial loss of braking effectiveness of the failed tires. The then-existing rejected takeoff requirements did not make allowance for wet or slippery runways and tire failures.

Jammed Elevator

DC-8-63, 8 September 1970, New York. This was a ferry flight from New York to Washington, D.C., where passengers were to board for a flight to London. There were 11 crew members. The accident occurred in daylight conditions; weather was not a factor.

After a takeoff roll of only 2,800 feet the aircraft became airborne and rotated to a nose-high attitude estimated between 60° and 90°. It then began to roll and struck the ground in a nose-down attitude with the wings in a near-vertical position. There were no survivors.

The accident was attributed to a "loss of pitch control caused by the entrapment of a pointed, asphalt-covered object between the leading edge of the right elevator and . . . the aft part of the stabilizer." The object that jammed the elevator was probably a stone. A resurfacing program of paved areas on the airport was in progress at the time. Stones were found on nearly all taxiways and aprons used by the accident aircraft.

Loss of Instruments

Boeing 727, 18 January 1969, Los Angeles, Calif. This scheduled passenger flight was dispatched with an inoperative Number Three generator. Thirty seconds after takeoff into night instrument conditions, there was a fire warning on the Number One engine and the crew shut that engine down. Shortly thereafter, all generator power was lost and the standby electrical system either was not activated or failed to function. The aircraft crashed out of control into Santa Monica Bay when the crew had no reliable attitude reference inside or outside the cockpit. The 38 occupants were killed.

The inoperative Number Three generator was carried as a deferred item in accordance with the Minimum Equipment List; that action had been taken three days and 42 flight hours before the accident.

No evidence was found of an in-flight fire in the Number One engine. The reason why the standby electrical power system did not play its intended role could not be determined. It was theorized that the design and location of some of the electrical system's controls, in combination with a suddenly darkened cockpit, may have interfered with the crew's proper response to the emergency. One of the results of this disorientation accident was the mandatory installation of an independently-powered standby attitude indicator on all large turbojet aircraft.

Unknown Causes

Boeing 707-321, 23 July 1973, Tahiti. This was a scheduled passenger flight from Tahiti to Los Angeles. Less than one minute after the night takeoff, the aircraft made the prescribed turn to the left at lower than normal altitude and struck the surface of the water in near-level flight. Only one of the 79 occupants survived. Weather was not considered a factor.

A sonar exploration of the ocean floor accident area did not reveal the location of the wreckage. The inability to retrieve the flight data recorder, cockpit voice recorder and critical aircraft components, forced the Board of Inquiry to limit its analysis to a discussion of hypotheses. These included problems with the engines, flight controls, instrumentation, visual illusions and incapacitation. (Both pilots were 59 and were undergoing treatment for hypertension.)

Selected, Non-Fatal U.S. Accidents

Boeing 727 QC, 21 March 1968, Chicago, Ill. Early in the takeoff roll, the takeoff warning horn began to sound. While continuing the takeoff, the crew tried unsuccessfully to locate and correct the condition that caused the warning. Immediately after liftoff the stick shaker activated. The captain lowered the nose and added thrust but the aircraft failed to accelerate. He then decided to discontinue the takeoff. The aircraft struck a drainage ditch and was consumed by the postcrash fire. The three crew members survived.

The flaps were in the 2° rather than in the planned 5° position. (The 2° setting was outside the takeoff range.) It could not be determined how and when they came to be in that position. At the aircraft's gross weight the stall speed was 152 KIAS for 2° of flaps and 128 for 5° of flaps.

DC-8-63F, 16 October 1969, Stockton, Calif. This was a training flight. During a touch-and-go landing the captain rejected the takeoff because the takeoff warning horn sounded and the ground spoiler extend light illuminated. The remaining runway was insufficient for a safe stop. The aircraft was destroyed by fire. The five crew members were uninjured.

Investigation revealed that the spoiler light came on and the takeoff warning horn sounded due to a faulty electrical circuit. Maintenance records indicated "three prior discrepancies in the ground spoiler electrical system as the result of faulty microswitches."

Extract from the accident report: "The captain's decision to abort the takeoff is considered prudent. Any other action would have defeated the purpose of the warning system."

Boeing 747, 30 July 1971, San Francisco, Calif. While taxiing out to Runway 28L the crew learned that this runway was closed. After considerable discussion with the dispatcher and the tower, the flight was cleared to use the shorter Runway 01R. The original flap setting of 10° was changed to 20° but the crew did not recompute the takeoff reference speeds.

The erroneous reference speeds required a distance to liftoff that exceeded the available runway length. The aircraft was rotated as it crossed the departure end of the runway. The landing gear and aft fuselage struck the approach light system structure. Steel handrail sections penetrated the fuselage, cabin and vertical fin. The Numbers One, Three and Four hydraulic systems were disabled; some debris passed within four inches of the Number Two system.

The crew maintained control of the aircraft, climbed to a safe altitude, and began to assess the damage. After learning that the right bogie beam and two wheels of the left bogie beam were missing, the crew dumped fuel and made an emergency landing on reopened Runway 28L. The combined experience of the five-man crew was almost 90,000 hours.

DC-10-30, 12 November 1975, New York. During the takeoff roll, the right engine ingested a number of sea gulls and disintegrated. Fire erupted immediately in the right pylon area. The aircraft could not be stopped on the (wet) runway because of several simultaneous system failures. To avoid a blast fence at the end of the runway the captain attempted to turn into the last taxiway. The right landing gear collapsed and the right wing fractured in the Number Three fuel tank area. Fuel accumulated in a storm drain beneath the aircraft; the fire burned for 36 hours. All 189 occupants were company employees; there were no fatalities.

DC-9-14, 16 November 1976, Denver, Colo. The captain rejected the takeoff when the stall warning stick shaker activated as the aircraft was being rotated. The aircraft could not be stopped within the confines of the runway and was severely damaged by impact and fire. All 86 occupants survived.

The stall warning was attributed to a malfunction of the stall warning system. The exact failure mechanism could not be determined; several of the system's components were destroyed by fire.

An extract from the accident report stated: "Although, in retrospect, it is evident that the aircraft would have lifted off normally, had rotation to the proper pitch angle been continued, the persistence of the stick shaker caused the crew to perceive this as a valid warning. The Safety Board believes that pilots have a right to rely on mandatory warning systems and are trained to do so."

DC-10-30, 22 September 1981, Miami, Fla. Shortly after the 80 KIAS check the crew heard a "hollow boom" followed by aircraft vibrations and yawing to the right. The captain rejected the takeoff and brought the aircraft to a safe stop. During the deceleration the crew noted unusual readings on the Number Three engine instruments but the engine failure light did not illuminate. There was no fire.

The Number Three engine failure was the result of the fragmentation of the Stage One low-pressure turbine rotor disk. Some of the effects of the uncontained failure were:

- The Number Three engine thrust lever control cable was severed;

• The slat follow-up cable was cut and the right wing outboard slat group almost completely retracted;

• The Numbers One and Three hydraulic systems became inoperative due to lack of fluid;

• The firewall fuel shutoff capability of the Number Three engine was lost; and,

• Fire extinguishing agent of the Number Three engine could not be discharged.

The stall warning systems on DC-10s had been modified following the DC-10 accident in Chicago in May 1979. Therefore, "the Safety Board believes that, had the engine failure occurred after V_1, the flight crew would have been able to continue the takeoff and could have landed the aircraft safely."

Boeing 747, 11 October 1983, Frankfurt/Main, West Germany. This was a cargo flight. During the takeoff acceleration, one of the cargo palettes slid backwards and the aircraft rotated to a nose-up attitude. The captain rejected the takeoff at about 60 KIAS. The aircraft was substantially damaged; there were no injuries.

Convair 990, 17 July 1985, March AFB, Calif. (Although this accident involved a U.S. National Aeronautics and Space Administration (NASA) aircraft, it is included here because it highlights what could be called the Achilles' heel of jet transports: disintegrating tire/wheel assemblies. This summary is based on a presentation by a NASA representative.[2])

Toward the end of the takeoff roll, the crew heard two rapid explosive bangs which they recognized as blown tires. The speed at the time was eight knots below a V_1 of 151 KIAS. The crew rejected the takeoff immediately. Light braking was used because the balanced-field length was 2,800 feet less than the actual runway length of 13,300 feet. The aircraft was brought to a stop 600 feet before the end of the runway.

During the intentionally extended rollout, fragments of the tires or the wheel/brake assemblies of the right main landing gear punctured the wing fuel tank and ignited. The aircraft was completely destroyed by the ensuing fire. The four-man crew and the 15 scientists and technicians evacuated the aircraft without serious injuries.

Investigation revealed that the aircraft began shedding rubber about 1,500 feet into the takeoff roll. A technician in the aircraft who was watching a television monitor linked to a camera focused on one of the tires of the right main gear noticed deformation of the tire early in the takeoff roll. Another technician with a view of the right wing caught a fleeting glimpse of a "black object flying over the wing." These observations were not relayed to the flight crew.

Perhaps the most interesting comment on this accident was made in the abstract of the report on which this summary is based: "The NASA Accident Investigation Board was somewhat perplexed that an aircraft could be destroyed as a result of blown tires during the takeoff roll."

Selected Non-U.S. Accidents

Boeing 747, 20 November 1974, Nairobi, Kenya. Following a normal takeoff roll the aircraft became airborne in a partially stalled condition. When the pilot who was flying realized that impact with the ground was imminent he closed all four throttles. Total airborne time was 35 seconds. The aircraft was destroyed by impact and fire. Of the 156 occupants 59 were killed.

The crew had initiated the takeoff with the leading edge slats retracted; the pneumatic system which operates them had not been switched on after the engines were started. Several leading edge flaps incidents had occurred in the past but the international incident reporting system failed to alert all parties involved.

Boeing 747, 1 January 1978, Bombay, India. Less than two minutes after a night takeoff, the aircraft crashed into the sea in an unusual attitude with the loss of all 213 persons on board. The Court of Inquiry attributed the accident to disorientation on the part of the captain when his attitude director indicator (ADI) failed and he did not avail himself of the backup flight instruments. It appears that the ADI failure flag did not come into view.

The Court found that the copilot failed to monitor the flight instruments and did not assist the captain in ascertaining the attitude of the aircraft. The flight engineer appears to have advised the captain to go by the standby attitude indicator; this occurred when the bank angle was about 90°.

Boeing 737-200, 22 August 1985, Manchester, United Kingdom. The following information was obtained from aviation periodicals. About 15 knots below rotation speed the crew heard an explosion and rejected the takeoff. Their first impression was that they were dealing with a burst tire or impact with a foreign object such as a bird. They had no problem decelerating the aircraft and clearing the runway.

Actually, the noise they heard was associated with the uncontained failure of the left engine when one of the burner cans ruptured. Fuel spilled from a punctured fuel tank and was ignited immediately. The fire rapidly spread to the fuselage. Of the 137 occupants 55 died as a result of the fire.

NOTE: See “The Manchester Accident — The Final Chapter,” *FSF Flight Safety Digest*, February 1989.

Closing Comments

Considering the millions of uneventful takeoffs each year it can be argued that exclusive focus on takeoff accident scenarios distorts the industry’s safety performance. True as this may be, the fact remains that too many of these mishaps were triggered by uncritical acceptance of operational, procedural and technical compromises.

One U.S. airplane manufacturer estimates that about one in 2,000 initiated takeoffs is rejected. Since the yearly number of Part 121 departures in the United States is close to 7,000,000, there could be 3,500 rejected takeoffs annually, or an average of 10 each day. Most of these rejections occur well below V_1 speed and create no serious problems. However, these thousands of successfully rejected takeoffs should not obscure the fact that practically all of them involve the crew’s response to conditions, discrepancies and failures they find unacceptable. Thus, there are reasons to believe that the few takeoff accidents which create headlines present only the tip of an iceberg of system discrepancies.

In recent years, pilots have been urged to be go-minded based on the belief that rejecting a takeoff at speeds near V_1 brings more risk than continuing the takeoff. This may be sound advice, considering the lack of realism in the V_1 concept for runway-limited conditions, the unreliability of warning systems and the hazards in the overrun areas of many airports. However, to the extent that such advice is motivated by concern about these unsatisfactory conditions, it should be used with caution.

In at least eight of the fatal U.S. takeoff accidents, it was not until the aircraft had reached rotation speed, or passed the end of the runway, that the crew found out they had controllability problems. What is the consensus on the captain’s best option under these circumstances?

Since the flight crew is at the receiving end of the system’s shortcomings — as well as their own — there is a tendency to treat crew preparedness for emergencies as the principal countermeasure. This approach works well when time and information constraints do not cripple the crew’s decision-making process and initiative.

For example, the pace of operations and the reduced power settings during approach and landing seldom deprive a competent crew of the dependable option to make a go-around. However, an emergency during the critical phase of takeoff (near, or at V_1) demands an almost instantaneous response to information that may be incomplete, misleading or beyond the crew’s analytical capability.

This review of some of the problems that have confronted flight crews during the two-minute takeoff phase leads to a sobering conclusion: if as much attention were devoted to the **prevention** of takeoff emergencies as to the crew’s response to them, the accident record would improve considerably.

After all, a takeoff is more than a by-the-number ritual that tranforms a waddling duck into a soaring bird. It is an ever-recurring test of the flyability of the airplane, the competence of its crew, and the integrity of the system behind them. ♦

References

[1]Capt. Heino Caesar, “International Jet-Loss Statistics.” Presented at the 41st Flight Safety Foundation Seminar, Sydney, Australia, 5 December 1988.

[2]Byron E. Batthauer, “Analysis of Convair 990 Rejected-Takeoff Accident,” Presented at the 40th Annual International Air Safety Seminar of the Flight Safety Foundation, October 26-29, 1987, Tokyo, Japan.

Reports Received at FSF Jerry Lederer Aviation Safety Library

Reports:

Aeronautical Decision Making for Commercial Pilots. Final Report. R.S. Jensen and J. Adrion. Systems Control Technology, Inc. July, 1988. (U.S.) FAA contract DTFAO1-80-C-10080. Report No. DOT/FAA/PM-86/42. 65 p. Available: NTIS.*

Aviation accident data indicate that the majority of aircraft mishaps are due to judgment error. This training manual is part of a project to develop materials and techniques to help improve pilot decision making. Training programs using prototype versions of these materials have demonstrated 10 percent to 50 percent fewer mistakes. This manual is designed to explain the risks associated with commercial flying activities, the underlying behavioral causes of typical accidents, and the effect of stress on pilot decision making. It provides a means for the individual pilot to develop an "Attitude Profile" through a self-assessment inventory and provides detailed explanations of pre-flight and in-flight stress management techniques. The assumption is that pilots receiving this training will develop a positive attitude toward safety and the ability to effectively manage stress while recognizing and avoiding unnecessary risk.

Annual Review of Aircraft Accident Data. U.S. Air Carrier Operations. Calendar Year 1986. (U.S.) National Transportation Safety Board. February 3, 1989. 102p. Report No. NTSB/ARC-89/01. Available: NTIS* — PB89-151021.

This publication presents the record of aviation accidents involving revenue operations of U.S. air carriers including commuter air carriers and on demand air taxis for calendar year 1986. The report is divided into three major sections according to the federal regulations under which the flight was conducted — 14 CFR 121, 125, 127, Scheduled 14 CFR 135, or Nonscheduled 14 CFR 135. In each section of the report tables are presented to describe the losses and characteristics of 1986 accidents to enable comparison with prior years.

Aircraft Accident Report — AVAir Inc. Flight 3378, Fairchild Metro III, SA227 AC, N622AV, Cary, North Carolina, February 19, 1988. (U.S.) National Transportation Safety Board. December 13, 1988. 72p. Report No. NTSB/AAR-88/10. Available: NTIS — PB88-910412.

Flight 3378 crashed in Cary, North Carolina, U.S. shortly after it departed Raleigh Durham International Airport. The airplane struck water within 100 feet of the shoreline of a reservoir, about 5,100 feet west of the midpoint of runway 23R. The airplane was destroyed and all 12 persons (2 flightcrew, 10 passengers) on board were killed. The NTSB determines that the probable cause of this accident was the failure of the flightcrew to maintain a proper flightpath because of the first officer's inappropriate instrument scan, the captain's inadequate monitoring of the flight, and the flightcrew's response to a perceived fault in the airplane's stall avoidance system. Contributing to the accident was the lack of company response to documented indications of difficulties in the first officer's piloting, and inadequate (U.S.) Federal Aviation Administration surveillance of AVAir.

Aircraft Accident Report — Ryan Air Service, Inc. Flight 103, Beech Aircraft Corporation 1900C, N401RA, Homer, Alaska, November 23, 1987. (U.S.) National Transportation Safety Board. December 20, 1988. 96p. Report No. NTSB/AAR-88/11. Available: NTIS* — PB88-910413.

About 1825 on November 23, 1987, Flight 103 crashed short of runway 3 at the Homer Airport, Homer, Alaska. Flight 103 was a scheduled Title 14 CFR Part 135 flight operating from Kodiak, Alaska, to Anchorage, Alaska, with intermediate stops in Homer and Kenai. Both flight crewmembers and 16 passengers were fatally injured; three passengers were seriously injured. The NTSB determines that the probable cause of this accident was the failure of the flightcrew to properly supervise the loading of the airplane which resulted in the center of gravity being displaced to such an aft location that airplane control was lost when the flaps were lowered for landing. The safety issues discussed in the report include the performances of the Be 1900, the Federal Aviation Administration's oversight of Ryan, and Ryan's management of its operation.

The Carriage and Use of Overwater Life-Support Equipment in Canada. Safety Study by the Canadian Aviation Safety Board. Report No. 88-SP0001. 1988. 32p.

The study examined Canadian and International Civil Aviation Organization (ICAO) accident data for both fixed and rotary winged aircraft for the years 1976-1987. This information was analyzed to determine if the various regulations governing the carriage, stowage, and use of overwater life-support equipment adequately met the needs they were designed for. The study also looked at the adequacy of the overwater life-support equipment such as life-jackets, life-rafts, slide/life-rafts, and flotation devices. This study revealed several deficiencies on the topic.

Industry practices have been principally directed by regulatory requirement. The Board has concluded that the requirements do not adequately address the circumstances actually encountered in accidents. In particular the underlying regulatory basis for carrying on-board life-jackets, which is predicated on a specific flight distance from shore, is inappropriate. Seven Aviation Safety Recommendations were forwarded to the Minister of Transport as a result of this study.

Analysis and Use of VAS Satellite Data. Final Report, August 1985-August 1988. Henry E. Fuelberg, Mark J. Andrews, John L. Beven II, et al. Florida State University Department of Meteorology U.S.. Contract No. NAG8-033. Report No. NASA CR-4218. March 1989. 88p. Available: NTIS*

VISSR = Visible-Infrared Spin-Scan Radiometer.

VAS = VISSR Atmospheric Sounder

Four interrelated investigations have examined the analysis and use of VAS satellite data. A case study of VAS-derived mesoscale stability parameters suggested that they would have been a useful supplement to conventional data in the forecasting of thunderstorms on the day of interest. A second investigation examined the roles of first guess and VAS radiometric data in producing sounding retrievals. Broad-scale patterns of the first guess, radiances, and retrievals frequently were similar, whereas small-scale retrieval features, especially in the dew points, were often of uncertain origin.

Two research tasks considered 6.7 micron middle tropospheric water vapor imagery. The first utilized temperature. Subsidence associated with a translating jet streak was important. The second task involving water vapor imagery investigated simulated imagery created from LAMPS output and a radiative transfer algorithm. Simulated image patterns were found to compare favorably with those actually observed by VAS. Furthermore, the mass/momentum fields from LAMPS were powerful tools for understanding causes for the image configurations.

Safety Management in the Cockpit. Swiss Reinsurance Company, Zurich. Based on a text by Dr. Charles Ott, Zurich. November, 1988. 40p.

In today's large commercial aircraft, most of the steering is done by autopilots rather than human pilots. Therefore, the "actual flyer has become a manager whose work differs very little from that of a business manager in a company. He possesses human and technical resources which he applies in the right place, coordinates and uses to make decisions. The range and purpose of his activity differ greatly from those of a business manager however. Whereas the business manager's main concern is possible profit, all the pilot's actions are aimed at maximum safety for his passengers and the crew. He thus becomes a safety manager."

This report focuses on man as causer of accidents, and cockpit management. In summary, the report states: "The most important means of recognizing problems and risks in aviation and avoiding or limiting them in good time is flawless cockpit management. This is the result not only of existing regulations and procedures, but also of thoughtful teamwork by all crew members, of their planning and mutual assessment of the flight and their spontaneous initiative and mutual support in the cockpit. This responsible teamwork is sharpened and sensitized by periodic exchanges of experience and the leadership of the captain."

*U.S. Department of Commerce, National Technical Information Service (NTIS), Springfield, VA 22161 U.S. Telephone: 703-487-4780.

Regulations/Advisories:

AC No. 00-54. *Pilot Windshear Guide.* 11/25/88. U.S. Federal Aviation Administration. 56p.

This advisory communicates key windshear information relevant to flightcrews. Appendix 1 of this advisory circular is the Pilot Windshear Guide, which is only one section of the two-volume Windshear Training Aid. (The other components of the Windshear Training Aid — Windshear Overview of Management, Windshear Substantiating Data, Example Windshear Training Program, and two training videos — may be purchased from NTIS.*) A multimedia package, including video tapes, slides and the Windshear Training Aid, may be purchased from the U.S. National Audiovisual Center (301-763-1986).

AC No. 120-42A. *Extended Range Operation with Two-Engine Airplanes (ETOPS).* 12/30/88. U.S. Federal Aviation Administration. Cancels AC 120-42 dated June 6, 1985.

This AC states an acceptable means, but not the only means, for obtaining approval under FAR Section 121.161 for two-engine airplanes to operate over a route that contains a point farther than one hour flying time at the normal one-engine inoperative cruise speed (in still air) from an adequate airport. Specific criteria are included for deviation of 75 minutes, 120 minutes or 180 minutes from an adequate airport.

AC No. 150/5100-14B. *Architectural Engineering, and*

Planning Consultant Services for Airport Grant Projects. 11/21/88. U.S. Federal Aviation Administration. 22p. Cancels AC 150/5100-14A dated February 7, 1985.

This AC provides guidance for airport sponsors in the selection and employment of architectural, engineering, and planning consultants under FAA airport grant programs.

AC No. 150/5100-16A. *Airport Improvement Program Grant Assurance Number One — General Federal Requirements. 10/4/88.* U.S. Federal Aviation Administration. Cancels AC 150/5100-16 dated July 22, 1985.

Describes the general Federal requirements contained in Assurance 1 or the Grant Assurances required by the Airport and Airway Improvement Act of 1982, as amended. It is intended for sponsors receiving assistance under the Airport Improvement Program (AIP).

(U.S.) Federal Aviation Regulations. Part 135 — Air Taxi Operators and Commercial Operators. Change 30.

This change incorporates two amendments in FAR Part 135:

Amendment 135-28, Anti-Drug Program for Personnel Engaged in Specified Aviation Activities, effective December 21, 1988, and

Amendment 135-29, Foreign Repair Station Rules, effective December 22, 1988.

♦

Aviation Statistics

Worldwide Airline Jet Transport Aircraft Fatal Accidents and Hull Losses

An Update of Calendar Year 1988

"How safe is air travel? Mathematicians of the Massachusetts Institute of Technology have a reassuring answer." reported the Federal Aviation Administration in its weekly publication, "After calculating aviation accident rate, MIT says that a person could take **a flight every day** for more than 29,000 years before being involved in a fatal crash."

The following is an annual update of worldwide airline jet transport fatal accidents, hull-losses and rates which is a series of safety information not originated from the MIT but compiled since late sixties by the Flight Safety Foundation from News media and aircraft manufacturers. In any years if the required operation and safety data were not obtained by manufacturers of jet transport aircraft, the annual hours flown were estimated based upon data available from other sources, including governmental and international organizations. However, no information was directly from the airlines operating the following aircraft:

Two-engine jet:	SE-210, F-28, B-737, B-757, B-767, DC-9, MD-80, BAC-111, A-300, A-310/320
Three-engine jet:	B-727, L-1011, DC-10, Trident
Four-engine jet:	B-707/720, B-747, DC-8, BAe-146, Convair 880/990, VC-10, Comet.

In 1988, worldwide airlines operating these jet transport aircraft recorded 13 hull losses and 15 fatal accidents accounting for a total of 915 fatalities, including one A-300 shot down by military action over Persian Gulf on July 3, and one suspected sabotage B-747 accident occurring on December 7 over Lockerbie, Scotland. A total of 515 aboard these two aircraft and 11 persons on the ground perished. The following six tables present an overview of the worldwide airline annual operation and safety records including aircraft daily utilization, and analysis of fatal accidents and hull-losses and rates.

For comparison purpose, Table 1 presents number of active jet transportation aircraft operated by U.S. airlines and Non-U.S. airlines. In 1988, worldwide jet transport aircraft flew a total of 19,149,000 hours, an increase of five percent over 18,224,000 in 1987. U.S. airlines accounted for 47.4 percent of total hours flown while all non-U.S. airlines accounted for 52.6 percent. The increase rates of U.S. airlines is slightly bigger than that of all non-U.S. airlines.

Table 1 — Worldwide Airlines Jet Transport Active Aircraft and hours Flown Calendar Year 1987-1988

	1987	1988	Changes	
Active Aircraft as of December	7,223	7,763	+540	(7.5%)
U.S. Airlines	3,350	3,650	+300	(9.0%)
Non-U.S. Airlines	3,873	4,113	+240	(6.2%)
Hours Flown Annual Total	18,224,000	19,149,000	+925,000	(5.0%)
U.S. Airlines	8,365,000	8,902,000	+537,000	(6.5%)
Non-U.S. Airlines	9,859,000	10,247,000	+388,000	(3.9%)

Table 2 presents the number of aircraft in service at the end of 1988 and the flight hours by three different aircraft types and the accumulative flying hours since 1959. It appears that the airlines used more and more fuel efficient twin-engine jets in recent years to reduce operating costs. In 1988, the twin engine jet accounted for 53 percent of total jet transport aircraft fleet as compared with only 34 percent at the beginning of the decade.

Table 2 — Worldwide Airline Jet Transport Aircraft Hours Flown in Thousand By number of jet engine 1959-1988

Aircraft Type	No. of Aircraft in service 1988 Dec. 1987	Hours Flown CY 1988 CY 1987	Accumulative Total hours 1959-1988 1959-1987
Two-engine	4,229	10,534,000	105,677,000
Three-engine	2,297	5,542,000	93,825,000
Four-engine	1,237	3,073,000	98,832,000
Total	7,763	19,149,000	298,324,000
Two-engine	54.5%	55.0%	35.4%
Three-engine	29.6%	29.0%	31.5%
Four-engine	15.9%	16.0%	33.1%
Total	100.0	100.0	100.0
1st generation	550	578,000	81,158,000
2nd generation	4,446	10,380,000	149,711,000 1/
Widebody	1,527	4,842,000	52,162,000 1/
Efficiency	1,240	3,349,000	15,293,000 2/
Total	7,763	19,149,000	298,324,000
1st generation	7.1%	3.0%	27.2%
2nd generation	57.3%	54.2%	50.2%
Widebody	19.7%	25.3%	17.5%

(table continued on next page)

(table continued from page 13)

Aircraft Type	No. of Aircraft in service 1988 Dec. 1987	Hours Flown CY 1988 CY 1987	Accumulative Total hours 1959-1988 1959-1987
Efficiency	15.9%	17.5%	5.1%
Total	100.0	100.0	100.0
Two-crew	4,329	10,779,000	106,617,000
Three-crew	3,434	8,370,000	191,707,000
Total	7,763	19,149,000	298,324,000
Two-crew	55.8%	56.3%	35.7%
Three-crew	44.2%	43.7%	64.3%
Total	100.0	100.0	100.0

1/ Readjusted since 1987.
2/ Efficiency jet includes B-757, B-767, MD-80, MD-81, A-310, A-320.

Table 3 provides a comparison of daily utilization for the past two years by three different categories of aircraft types. Note that in 1988, the average daily utilization for all type aircraft is slightly less than 1987. This reduction of daily usage could be attributed to over 9 percent increase of aircraft in service vs. only 6 percent increase of aircraft hours flown because the new aircraft delivered in 1988 did not have a whole year utilization. Actually, the utilization rates of all types of aircraft in 1988 had no change at all over 1987.

Table 3 — Daily Utilization of Jet Transport Aircraft By Aircraft Type 1987-1988

Aircraft Type	Average daily utilization (Hours) 1987	1988	Change
Two-engine	6.9	6.7	- 0.2
Three-engine	6.8	6.6	- 0.2
Four-engine	6.9	6.8	- 0.1
1st generation	3.2	2.9	- 0.3
2nd generation	6.6	6.4	- 0.2
Widebody	8.9	8.0	- 0.8
Efficiency	7.9	7.4	- 0.5
Two-crew	7.0	6.8	- 0.2
Three-crew	6.8	6.8	——

Table 4 shows the distribution of worldwide airline fatal accidents and hull-losses by phrase of operation. Table 5 shows the distribution of fatal accidents and hull-losses and rates by aircraft make/model entering into service in different time periods. Table 6 presents the fatal accident and hull-loss rates by aircraft with different number of engine and different number of flight crew.

Table 4 — Fatal Accidents and Hull-Losses By Phase of Operation 1959-1988

Takeoff/ Climb	Cruise	Fatal Accidents Approach/ Landing	Ground	Year
14(43.8)	3(9.3)	15(46.9)	0(0.0)	59-64
14(25.5)	7(12.7)	34(61.8)	0(0.0)	65-69
18(24.0)	16(21.3)	41(54.7)	0(0.0)	70-74
16(28.0)	12(21.4)	27(48.2)	1(1.8)	75-79
15(27.2)	13(23.6)	25(45.5)	2(3.7)	80-84
5(45.5)	1(9.0)	5(45.5)	0(0.0)	1985
2(40.0)	1(20.0)	2(40.0)	0(0.0)	1986
4(30.8)	3(23.1)	6(46.1)	0(5.6)	1987
4(26.7)	4(26.7)	7(46.6)	0(0.0)	1988
92(29.0)	60(18.9)	162(51.1)	3(1.0)	59-88

Ground	Approach/ Landing	Hull-Losses Cruise	Takeoff/ Climb
1(2.4)	22(53.7)	4(9.8)	14(34.1)
6(8.1)	41(55.4)	7(9.5)	20(27.0)
11(11.0)	52(52.0)	12(12.0)	25(25.0)
6(5.7)	43(51.2)	11(13.1)	24(28.6)
7(10.3)	37(54.4)	8(11.8)	16(23.5)
1(7.7)	6(46.1)	1(7.7)	5(38.5)
1(11.1)	5(55.5)	1(11.1)	2(22.3)
1(7.7)	5(38.5)	3(23.1)	4(30.7)
0(0.0)	6(46.1)	2(15.4)	5(38.5)
34(8.2)	217(52.3)	49(11.8)	115(27.7)

Table 5 — Worldwide Airline Jet Transport Fatal Accidents, Hull-Losses and Rates

1959-1987

Number of Fatal Accidents and Hull-Losses*

	1st Generation		2nd Generation			Widebody			Efficiency 1/	
	Fatal	HU-LOS	Fatal	HU-LOS		Fatal	HU-LOS		Fatal	HU-LOS
1959-1964	32	41	—	—		—	—		—	—
1965-1969	34	47	21	27		—	—		—	—
1970-1974	41	51(54)	30	37(41)	4(5)	3(5)		—	—	
1975-1979	23	35(36)	26	36(37)	7	11		—	—	
1980-1984	12	18	32	40		11	9(10)		—	—
1985	2	1	6	8		3	4		—	—
1986	0	1	5	7		0	1		—	—
1987	3	3	6	6		2	2		2	2
1988	3	3	7	7		1(3)	0(2)		2	1
Total	150	200	133	168		28	30		4	3

Rates per 100,000 Flying Hours

	1st Generation Fatal	1st Generation HU-LOS	2nd Generation Fatal	2nd Generation HU-LOS	Widebody Fatal	Widebody HU-LOS	Efficiency 1/ Fatal	Efficiency 1/ HU-LOS
1959-1965	.342	.438	—	—	—	—		
1965-1969	.115	.159	.197	.252	—	—		
1970-1974	.179	.236	.109	.135	.111	.082		
1975-1979	.133	.203	.075	.104	.062	.098		
1980-1984	.157	.235	.072	.090	.051	.050		
1985	.244	.122	.062	.084	.046	.063		
1986	—	.159	.047	.065	—	.014		
1987	.451	.451	.058	.058	.428	.428	.074	.074
1988	.519	.519	.007	.007	.002	—	.059	.029
ALL	.184	.246	.088	.112	.055	.059	.023	.017

*Aircraft destroyed by force are excluded from computation of rates.

Table 6 — Worldwide Airline Jet Transport Fatal Accidents Hull-Losses and Rates 1959-1988

		Jet Transport Aircraft					
		Two-Engine	Three-Engine	Four-Engine	Two-Crew	Three-Crew	All Aircraft
Fatal Accidents	CY 1988	3(4)	6	4(5)	4(5)	9(10)	13(15)
	Accumulative As of 1988	109	63	144	97	218	315
Hull Losses	CY 1988	2(3)	6	3(4)	2(3)	9(10)	11(13)
	Accumulative As of 1988	146	71	184	129	272	401
Hours per Fatal Accident	CY 1988	3,511	923	768	2,694	930	1,473
	Accumulative As of 1988	960	1,489	686	1,171	879	941
Hours per Hull-Losses	CY 1988	5,267	923	1,024	5,267	930	1,740
	Accumulative As of 1988	718	1,321	537	826	704	743

The following figure shows the 30 year fatal accident rates and trends of worldwide jet transport aircraft since 1959. Over the 30 year period, worldwide airlines operating those jetliners recorded a total of 298 million flying hours and were involved in 315 fatal accidents. It averaged 946,000 flying hours per fatal accident. Should such a safety record prevail, **a person could take a flight from Washington D.C. to New York City every day for more than 2,500 years before being involved in a fatal crash.**

Accident/Incident Briefs

The following information on accidents and incidents is intended to provide all those involved in aviation with an awareness of problem areas through which they can help prevent future such occurrences.

Air Carrier

Low and Slow on Final

Brazil - March

Boeing 707: Aircraft destroyed. Fatal injuries to three on aircraft and 18 on ground. Other injuries to 200 on ground.

The aircraft was carrying a 20-ton cargo of manufactured products from Manaus and was approaching Sao Paulo's Guarulhos International Airport for landing just before noon. The weather was clear and a visual approach was being made. The pilot reportedly had radioed that there was a problem with the hydraulic system and the landing gear.

Approximately 1.5 miles short of the runway, the aircraft was seen by witnesses to apparently graze a building with one of its engines, then veer to the left and crash through a crowded slum area. It exploded and burst into flames, killing the three-person crew and numerous people on the ground. Officials reported that about 200 people on the ground were injured, many suffering from severe burns.

The accident severed power cables, causing an electrical outage that hampered rescue operations. Approximately 80 small wood and brick structures were damaged or destroyed in the Jardim Ipanema neighborhood.

Initial speculation, according to Aeronautics Ministry sources, indicated that the cargo jet had its flaps set too low and was flying about 15 mph slower than its minimum 135 mph final approach speed, a combination that was considered contributory to a possible sudden loss of altitude.

Fire after Takeoff

United States - March

Boeing 737: Damage to APU and rear of fuselage. No injuries.

The twin-jet air carrier had taken off from Oakland International Airport, Calif., for Denver, Colo., with a crew of five and 64 passengers aboard.

About an hour into the flight, at an altitude of about 33,000 feet, the pilot reported vibrations and requested that emergency equipment stand by at San Francisco International Airport where he had decided to make an emergency landing. The aircraft made a safe landing and there were no injuries. Cause of the incident was attributed to an auxiliary power unit that apparently malfunctioned and possibly overheated. The rear section of the aircraft was damaged with paint burned off from the fuselage and part of one side of the horizontal stabilizer. No fire entered the passenger cabin.

Snowstorm Takeoff

Canada - March

Fokker F.28: Aircraft destroyed. Fatal injuries to 24; other injuries to 45.

The air carrier was fully loaded with 65 passengers, baggage and a crew of four, and had taken on additional fuel for a flight from Dryden Airport, in western Ontario, to Winnipeg. Weather was reported to have been variable, changing from light to heavy snow during the 10 minutes the aircraft waited at the end of the runway for takeoff clearance.

One passenger later reported that the aircraft seemed to

Accident/incident briefs are based upon preliminary information from government agencies, aviation organizations, press information and other sources. The information may not be accurate.

be laboring as it went down the runway, and others said it seemed to lack power. Shortly after takeoff, the aircraft crashed into a thickly wooded area less than a mile from the runway. It broke into three pieces and fire broke out. Three of the crew members and 21 passengers were killed. The survivors suffered various injuries, mostly burns; 27 were released from hospitals within five days. The flight data recorder and the cockpit voice recorder were both extensively damaged by the severe fire and the tapes were later found to have melted.

Survivors and other witnesses reported that the aircraft had accumulated a layer of wet snow on its wings prior to the takeoff.

Close Call for Trijets

United Kingdom - February 1988
(Final Report)

Lockheed L-1011 and Tupolev Tu-154: No damage. No injuries.

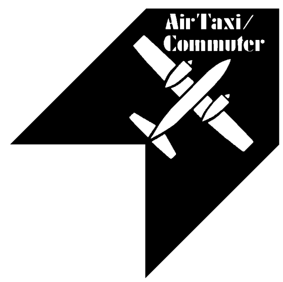
The U.K. Air Accidents Investigation Branch (AIB) has reported on its investigation of a near miss incident involving a British Lockheed L-1011 Tristar and a Bulgarian Tupolev Tu-154 as they both approached London airports.

Shortly before noon on the day of the incident, the L-1011 that had taken off from Paris was headed northwest for Heathrow Airport. It was approaching a position about 12 miles south-southwest of the Lydd navigation beacon that was southeast of Heathrow and south-southeast of Gatwick. Meanwhile, the Tu-154, having been cleared for descent to Gatwick, was leaving the holding pattern at the same navigational fix, turning from a westerly to a southerly heading.

At the time, an unusual and complex traffic situation had built up in the area because of a scheduled, temporary, closing of one runway at Gatwick and an emergency closure of a runway at Heathrow. As a result, traffic inbound to Gatwick was being held at Lydd and another fix, Eastwood, west of the first fix and southeast of Gatwick.

As the L-1011 was descending to Flight Level (FL) 180 on a radar vector toward Biggin Hill, northeast of Gatwick, a near midair collision occurred with the Tu-154. The Lydd hold for the latter had been cancelled and the aircraft was cleared to descend to FL 120 on a vector for positioning to an inbound radial to Eastwood. It was ordered to stop its descent at FL 180 and shortly afterwards, heading approximately south, was told to turn right immediately for avoidance action. During the turn, the Tu-154 passed very close in front of and sightly above the L-1011. The pilot of the L-1011 saw the other aircraft and took violent evasive action to avoid a collision. The other aircraft's crew was not in a position to see the L-1011 because it was banked in the turn. Both aircraft were under positive radar control and were following their clearances. Both landed safely at their respective destinations.

The AAIB report on the incident concluded that the primary cause of the near collision was lack of coordination between the two experienced ATC controllers who were handling the two aircraft in the same section of airspace, but on two different communications frequencies. The board pointed also to the lack of enough warning of impending traffic peaks, the lack of dual monitoring requirements between controllers, lack of a conflict alert warning system, and the lack of standardized procedures to coordinate scheduled runway closures with the inbound flow of traffic. Thirteen safety recommendations resulted to prevent future such occurrences.



Open Cargo Door at Night

United States - March

McDonnell Douglas DC-9: Aircraft destroyed. Fatal injuries to two.

The civilian DC-9 had been chartered by the military to haul a cargo of explosives from Carswell Air Force Base in Texas to Tinker Air Force Base in Oklahoma. The aircraft had been loaded with its cargo at Carswell and had just taken off shortly after midnight. Within a few moments, its crew radioed that they had noticed an open cargo door and that the aircraft would return to the military airport.

The aircraft did not make it back to the airport. It crashed nearby in a sparsely populated area in the vicinity of Saginaw, Texas. The aircraft was destroyed and the two crew members aboard were killed.

Approach in Fog

Peru - March

Pilatus Britten-Norman BN-2A Islander: Aircraft destroyed. Fatal injuries to 10.

The twin-engine aircraft was returning in the late afternoon from a sightseeing flight to Nazca, 240 miles southeast of Lima, with a crew of two and eight passengers. Weather was heavy fog and the aircraft was making an instrument approach to Jorge Chavez Airport in Lima.

About 2.5 miles short of the airport, the right wing of the aircraft hit a radio station antenna and the aircraft crashed into a building under construction at San Martin de Porres University. The fuselage impacted into the unfinished building and caught fire. One wing was found two blocks away. The aircraft was destroyed and there were no survivors; three persons on the ground were injured.

Fog over the Forest

Honduras - February

Douglas DC-6: Aircraft destroyed. Fatal injuries to 10.

The four-engine propeller aircraft had been chartered by the U.S. Agency for International Development to deliver non-military aid to the Nicaraguan Contra rebel camps in San Andres de Bocay, near the Honduras-Nicaraguan border.

The DC-6 had dropped food and gasoline to the rebels and was returning to Tegucigalpa in heavy fog late in the afternoon. The pilot made a routine radio call reporting that he was starting a final approach and that was the last call received. The aircraft crashed in La Tigra National Park about 17 miles from the airport in dense forest. Search and rescue operations were delayed by strong winds and bad weather.

The aircraft was destroyed and all its occupants, three crew members and seven passengers, were killed.

Second Try Worse

France - February

Vickers Merchantman: Aircraft destroyed. Fatal injuries to three.

The chartered aircraft was a cargo variant of the Vickers Vanguard, powered by four turboprop engines, that first flew in 1959. The pilot was attempting to take off for Paris on an early evening flight from Marseilles, after arriving earlier that day from Casablanca.

The first takeoff attempt was aborted by the pilot and a second try was underway. Half-way down the runway the aircraft had gained about 50 feet of altitude when it banked steeply to the right and crashed into a lagoon. Rescue workers were able to pull the body of one crew member from the water, but the other two were trapped inside. None survived. The aircraft was destroyed.

Communications Problem?

Azores, Portugal - March

Boeing 707: Aircraft destroyed. Fatal injuries to 144.

Early findings on the crash in March of the chartered air carrier aircraft into a mountain in the Azores point to a violation of navigational rules. The aircraft, full of Italian tourists and approaching for a regular fuel stop, was said to be flying 1,270 feet too low. It hit a 1,794-foot volcanic mountain at about the 1,730-foot level in an area where 3,000 feet was the minimum flying level, according to an official inquiry report.

Prepared by Portugal's Transport Ministry, the report pointed also to an overlapping of communications between the aircraft and the control tower at Santa Maria Airport which apparently interfered with the pilot's hearing instructions to fly at 3,000 feet, the level to which it had been cleared to descend. The aircraft's crew had made a routine contact with the tower three minutes before the crash, after which the tower reportedly made several unsuccessful attempts to contact it again. There had been no indication of problems and no distress signals were received from the aircraft.

Corporate Executive

Engine Failure after Takeoff

Argentina - March

Cessna 402: Aircraft destroyed. Fatal injuries to crew; various injuries to passengers.

Shortly after the twin-engine aircraft had taken off from La Rioja on a flight to Catamarca, it suffered an engine failure.

The pilot was reported by a surviving passenger to have attempted to return to the airport after the engine failed, but he was unable to do so and the aircraft crashed about five miles from the airport and caught fire. Approximately 15 seconds after impact, the aircraft exploded and the crew of two was unable to escape. The five passengers aboard suffered varying degrees of injuries. The aircraft was declared a total loss.

There reportedly had been an earlier problem with one of the engines, and maintenance had been performed on it during the morning prior to the late afternoon takeoff.

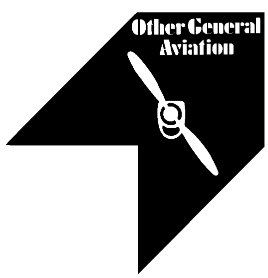
Final Landing

United Kingdom - February

de Havilland DH-89A Rapide: Aircraft destroyed. No injuries.

The aging twin-engine biplane was being operated by an oil company on a flight from Kidlington Airfield to Shoreham. En route, the right engine caught fire and the pilot made a forced landing in a field north of Oxford.

During the landing, the aircraft became inverted but the pilot was able to escape without injury. The aircraft, however, was destroyed by fire.



One to Think About

United Kingdom - March

Pilatus Britten-Norman BN-2T Turbine Islander: Aircraft damage not reported. One fatality.

The aircraft, operated by a parachute club, was returning from having dropped a number of sport parachutists. After landing at Headcorn airfield slightly after noon, the aircraft was taxiing from the runway when a female parachutist landed on one of the propellers and was killed.

Double Ditching

Mid-Atlantic - March

Cessna 210: Aircraft and pilot missing.
Piper PA-32-300: Aircraft and pilot missing.

A double tragedy occurred when a combination of ingredients put two lightplanes, travelling independently, into the Atlantic Ocean under hard-to-survive conditions. Both were headed from Canada to cross the Atlantic eastbound. Weather included a winter storm over the ocean that was described as "atrocious."

The Piper pilot radioed to advise he had oil pressure failure about 1,000 miles west of Shannon, Ireland, and was going to ditch. A U.K. Royal Air Force Nimrod was scrambled from Scotland and later spotted a flare in the area of the ditching but nothing was found.

The second aircraft, the Cessna 210, ditched 13 hours later only 120 miles from where the Piper had gone down.

The two downed pilots were the subject of an intensive, days long search by both RAF and Canadian Air Force aircraft. Some of what was thought to be the Piper's wreckage was spotted 800 miles off of Ireland but there were no reports of the pilot.

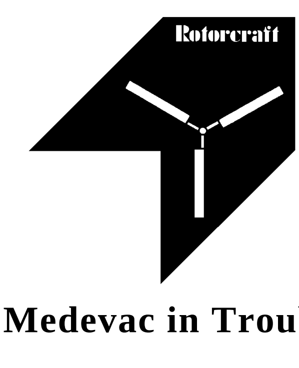
Low Fuel Flow over Water

Ireland - January

Piper (Model unspecified): Aircraft and pilot missing.

The aircraft was on a flight from Gander, Newfoundland, to Shannon Airport, Ireland, when the pilot radioed shortly before 9 p.m. that he had fuel flow problems, although there was plenty of fuel aboard. A later call reported that he had about 10 minutes left. Shannon ATC, which had been monitoring the aircraft, directed the pilot to the Aran Islands, just west of the Irish mainland, since it estimated that the aircraft would not be able to reach its intended destination.

The pilot failed to see the islands and overflew them. He ditched shortly after 9 p.m. off the northeast coast and helicopters from the Irish Air Corps and the Royal Navy, along with a local lifeboat were dispatched to the area. No sightings were reported.



Medevac in Trouble

United States - February

Kawasaki BK 117: Aircraft destroyed. Fatal injuries to three.

The new medical evacuation helicopter had set off from a hospital in Tyler, Texas, to pick up a heart patient in Pittsburg, about 40 miles away. The pilot was reported to have checked weather before leaving and had said that the rain and fog in the area was navigable. He took off slightly after 10 p.m. but within four minutes reported to the dispatcher that the rain and fog had worsened and that he was returning.

When the aircraft did not return, a search was started. The police found the wreckage of the helicopter in a heavily wooded area near the town af Pine Springs, seven miles north of Tyler. Deputies reported that the aircraft apparently had hit a utility tower and fell in pieces to the ground. There were no survivors among the three persons on board, two nurses and the pilot.

The heart patient was brought to the hospital by ground transport where his condition was stabilized.

Tripped by Cable

New Zealand - February

Bell 206B Jet Ranger: Helicopter destroyed. Fatal injuries to five.

The rotorcraft pilot was taking two couples on a scenic flight in the area of the resort of Queenstown on New Zealand's South Island. Weather was described as perfect.

All five persons on board were killed when when the helicopter apparently struck a disused cable left over from defunct gold-mining facilities. The aircraft exploded upon impact with a gravel area alongside a river in a gorge about 30 miles north of Queenstown.

Powerline Pitfall

France - February

Model helicopter not identified. Fatal injuries to four, serious injuries to one.

The rescue helicopter had been dispatched to aid a skier who had been injured near Chamberay, in the Valmorel area of France. The helicopter reportedly was piloted by the founder of the French air rescue service, Roland Freyssinet.

On board the helicopter in addition to the pilot were the injured skier, a doctor, a policeman and the pilot's daughter. Upon takeoff to transport the skier to a hospital, the aircraft was reported to have struck an electric power cable and crashed. The pilot's daughter, seriously injured, was the only survivor. The aircraft was destroyed.♦