FLIGHT SAFETY FOUNDATION

Accident Prevention

Vol. 60 No. 11 For Everyone Concerned With the Safety of Flight November 2003

Noncompliance With Instrument Approach Procedures Cited in King Air CFIT Accident in Australia

The report said that dark night conditions during the emergency medical services positioning flight also were a significant factor in the fatal controlled-flight-into-terrain accident.

FSF Editorial Staff

About 2336 local time on Dec. 10, 2001, a Raytheon Beech Super King Air B200C being flown on an emergency medical services (EMS) positioning flight struck the ground 3.1 nautical miles (5.7 kilometers) from Runway 18 at the Mount Gambier airport in Australia. The pilot was killed, and the medical crewmember received serious injuries. The airplane was destroyed.

The Australian Transport Safety Bureau (ATSB) said, in its final report, that significant factors in the accident were the following:

- "Dark night conditions existed in the area surrounding the approach path of the aircraft;
- "For reasons which could not be ascertained, the pilot did not comply with the requirements of the published instrument approach procedures; [and,]
- "The aircraft was flown at an altitude insufficient to ensure terrain clearance."

The accident flight departed from Adelaide, South Australia, at 2240 on an instrument flight rules flight plan to Mount Gambier, about 240 nautical miles (445 kilometers) southeast. The flight was estimated to take 52 minutes. The pilot planned to refuel the aircraft at Mount Gambier and then to transport a patient from Mount Gambier to Sydney, New South Wales, about 700 nautical miles (1,296 kilometers) northeast, for "a medical procedure for which time constraints applied," the report said.

After departure, the pilot flew the airplane to 21,000 feet. At 2308, he received from air traffic services (ATS) the most recent weather report for the Mount Gambier airport, including the altimeter reading of 1012 millibars (29.88 inches of mercury). At 2312, the pilot began the descent to Mount Gambier, and at 2324, the airplane descended through 8,200 feet — below ATS radar coverage.

"At approximately 2326, the pilot made a radio transmission on the Mount Gambier mandatory broadcast zone (MBZ) frequency advising that the aircraft was 26 [nautical miles; 48 kilometers] north, inbound, had left 5,000 [feet] on descent and was estimating the Mount Gambier circuit at 2335," the report said. "At about 2327, the pilot started a series of radio transmissions to activate the Mount Gambier PAL [pilot-activated lighting]. At approximately 2333, the pilot reported to ATS that he was in the circuit at Mount Gambier and would report after landing. … At approximately 2336 (56 minutes after departure), the aircraft impacted the ground."

The pilot of the accident airplane held an air transport pilot license and had accumulated 13,750 flight hours, including 372 flight hours in type and 1,390 flight hours at night.

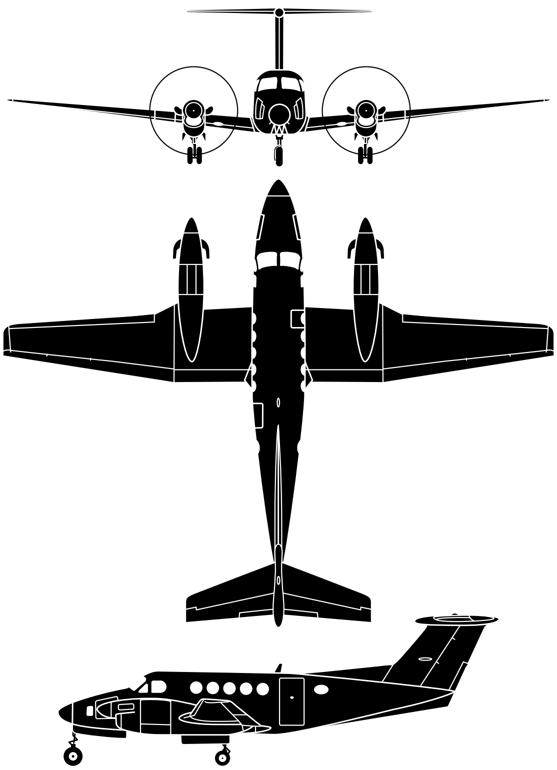
He had a Class 1 medical certificate, with vision correction required; the medical crewmember said that the pilot was in compliance with that requirement during the accident flight. There was no indication that the pilot had any medical condition that would have affected his conduct of the flight. The pilot had visited a medical practitioner about a week before the flight because of a cold and was given a prescription for an antibiotic; medical specialists said after the accident that the antibiotic would have had no adverse effects on pilot performance. The pilot also told the medical practitioner about his difficulty sleeping before night shifts or between night shifts and was given a prescription for medication to encourage sleep; a post-mortem toxicological analysis of the pilot's blood revealed no trace of the sleep medication.

The pilot was familiar with the accident airplane and had significant experience conducting night approaches to airports in remote locations; nevertheless, he had not often flown an aircraft to Mount Gambier, about 400 nautical miles (741 kilometers) northwest of his base at Port Augusta, South Australia. Logbook notations showed that the pilot's last flight to Mount Gambier was Aug. 19, 2001; there was no record that he had ever conducted a flight to Mount Gambier at night.

The pilot worked day shifts Dec. 4, Dec. 5 and Dec. 6 and was off duty the following three days before reporting for work at 1800 on Dec. 10 to begin what was to have been a four-day series of night-shift duties. Before the accident flight, the pilot had flown the airplane on another EMS flight from Port Augusta to Adelaide, a distance of about 165 nautical miles (306 kilometers).

"Based on interviews and a review of telephone records, the pilot obtained less than seven hours sleep on each of the nights of [Dec. 7 and Dec. 8]," the report said. "It could not be determined how much sleep the pilot had on Dec. 9. At about midday on Dec. 10, the pilot mentioned to an associate in a telephone conversation that he intended to have a sleep during the day. However, the maximum period of time between phone calls after this conversation and prior to 1800 was just under two hours."

The report said that although the pilot might have been fatigued at the time of the accident, the investigation was not able to determine the extent of fatigue or whether fatigue contributed to the accident. The report also said that the pilot might have been incapacitated just before the accident; nevertheless, he had no known medical condition that would have led to incapacitation.



Raytheon Beech Super King Air 200

Design of the Raytheon Beech Super King Air 200 business and utility twin-turboprop aircraft began in 1970. The first prototype flew in 1972. The aircraft has the same basic fuselage as the King Air 100 and has increased wingspan, more powerful engines, increased fuel capacity, increased cabin pressurization and a higher gross weight.

The aircraft is certified for single-pilot flight under U.S. Federal Aviation Regulations Part 91. The cockpit has two seats, and the cabin has six seats. Maximum cabin pressure differential is 6.5 pounds per square inch (0.4 bar). The cabin door is in the aft, left side of the fuselage. The aft fuselage accommodates a lavatory and a baggage compartment of 410 pounds (186 kilograms) capacity.

The B200C has two Pratt & Whitney PT6A-42 engines; each produces 850 shaft horsepower (634 kilowatts) and drives a Hartzell three-blade, metal propeller. Maximum fuel capacity is 3,645 pounds (1,653 kilograms).

Maximum takeoff and landing weight is 12,500 pounds (5,670 kilograms). Maximum cruise speed at 25,000 feet and average cruise weight is 289 knots. Maximum rate of climb at sea level is 2,450 feet per minute. Maximum single-engine rate of climb at sea level is 740 feet per minute. Stall speed with flaps up is 99 knots. Stall speed with flaps fully extended is 76 knots.♦

Source: *Jane's All the World's Aircraft*

Operator's Flight Manual Included CFIT Information

The operator, which was not identified in the report, said that its pilots received four training-and-check flights each year and an annual command multi-engine instrument rating renewal. The report said that the operator "reported satisfaction with the [accident] pilot's flying performance."

The operator said that company pilots conducted instrument approaches in one of two ways: "flying a considered descent rate and leveling at the steps" or "aiming for the 300-foot-per-minute profile."

"The operator also reported that, as all company operations are conducted single-pilot, the method of flying an instrument descent profile was seen as a personal preference," the report said. "As long as it was compliant and safe, … individual pilot[s] could use the method that they had been taught, had consolidated and were comfortable with."

The operator's *Flying Operations Manual (FOM)* included information about controlled flight into terrain (CFIT)[1] and about procedures for using aircraft altitude-awareness systems designed to provide "appropriate warnings to the pilot."

The manual said, "Part of the rationale behind these requirements is to provide a measure of protection against [CFIT], which is now the international leading accident cause. Not surprisingly, 80 percent of these accidents have occurred within 15 [nautical miles; 28 kilometers] of an airfield. What is surprising, though, is that half of these have occurred through descent into relatively flat terrain."

The accident airplane was manufactured in 1982 and had accumulated 10,908 flight hours. The last maintenance was routine Phase 4 and Phase 5 maintenance, conducted Oct. 16, 2001.

Airplane Had Multiple Altitude-information Systems

The airplane was equipped with the following systems to provide altitude information:

- A global positioning system (GPS), with a database that was valid until Dec. 26, 2001;

- An encoding altimeter, which displayed altitude with both a counter drum and a pointer calibrated in 20-foot increments. A Jan. 19, 2001, inspection of the altimeter and pitot-static system revealed no anomalies;

- A radio altimeter, which the company *FOM* said should be set to 500 feet or — during an instrument approach — to minimum descent height or decision height. After a pilot selected a height using the decision-height knob, advisory lights on the radio altimeter and the attitude indicator illuminated when the aircraft was flown below that height;

- An altitude-alerting system designed to provide an aural warning and a visual warning if the airplane deviated by 250 feet or more from a selected altitude. The company *FOM* said that, when conducting a descent outside controlled airspace in instrument meteorological conditions or at night, pilots should set the altitude-alerting system to the route's lowest safe altitude or the destination minimum sector altitude. The manual said that, when beginning an instrument approach (or later, with the altitude preselect controller in use), the system should be set to the missed approach altitude.

  "The system did not permit the pilot to prevent activation of the altitude aural alert," the report said. "In addition, no volume control was provided. No aural alert was heard on the cockpit voice recorder (CVR) recording"; and,

- A voice advisory unit that provided advisories from a digitized voice at various altitudes, depending on the altitude selected on the radio altimeter and the altitude-alerting system. The pilot could stop the advisories by activating a switch on the instrument panel.

  "Company pilots reported that the unit produced an excessive number of aural alerts," the report said. "In particular, they reported six or more alerts within the last 1,000 feet during an approach to land, which was distracting and interfered with normal communications. They reported that it was common practice for pilots to inhibit the voice advisory due to that distraction. Notwithstanding, inhibition of the voice advisory would have been replaced by aural alerts from the altitude-alerting system."

  The CVR contained a voice advisory that was recorded when the airplane was flown through 19,700 feet during the descent to Mount Gambier. No subsequent voice advisories were recorded.

  The accident airplane was the only one of the operator's three Super King Airs that was equipped with the voice advisory system, and the operator's *FOM*, which discussed standard procedures for the three aircraft, contained no information about the voice advisory system.

The airplane was not equipped with a ground-proximity warning system (GPWS); one was not required.[2]

Airplane Appeared to Be Functioning Normally

The CVR contained no indication from the pilot that the airplane was functioning abnormally. The recording included engine noise and propeller noise in which no anomalies were detected, and included the sound of the pilot extending the landing gear and increasing the propeller speed in preparation for landing.

The last voice recording of the pilot by the CVR occurred 2.5 minutes before the accident; the report said that there was no indication on the recording that the pilot saw the ground before impact.

Communications between the pilot and ATS, which were recorded by ground-based equipment, also contained no indication of any anomalies.

The airplane was not equipped with a flight data recorder; one was not required.

Low Visibility Prevailed at Time of Accident

During the flight, ATS told the pilot that the most recent forecast for the Mount Gambier airport included winds from 240 degrees at six knots to 10 knots, visibility of seven kilometers (four statute miles), light drizzle, scattered clouds at 800 feet, broken clouds at 3,500 feet, temperature and dew point both 11 degrees Celsius (C; 52 degrees Fahrenheit), and barometric pressure of 1012 millibars (29.88 inches of mercury).

As the pilot conducted the descent, the airport automatic weather-broadcasting system reported that weather conditions included wind from 230 degrees at six knots, humidity of 96 percent, no rainfall during the previous 10 minutes, temperature and dew point both 11 degrees C and barometric pressure of 1012 millibars. The report did not mention ceiling or visibility.

At the time of the accident, no other aircraft were in the area. Conditions included low clouds, rain showers, moderate winds and low visibility. There was no visible moon.

Mount Gambier airport is about five nautical miles (nine kilometers) north of Mount Gambier Township at an elevation of 212 feet. The airport has three runways, with Runway 18/36 preferred for public transport aircraft. Witnesses near the airport said that the PAL was illuminated at the time of the accident, and subsequent tests indicated that the system was functioning correctly. The report said that company pilots described the airport lighting as "difficult to see when flying from the direction of Adelaide, which was to the northwest of Mount Gambier; however, there were no reports that the lighting was difficult to see when on approach to the runway."

The runway had an abbreviated "T" visual approach slope indicator system (AT-VASIS),[3] set at three degrees to the horizontal. The AT-VASIS was designed to illuminate with activation of the pilot-activated lighting. Post-accident tests indicated that the system was functioning properly, and there was no indication that it was not illuminated at the time of the accident.

A very-high-frequency omnidirectional radio (VOR) and a nondirectional beacon (NDB) were available for radio navigation. Radar data showed that the airplane was tracking from Adelaide to Mount Gambier, "probably with reference to the VOR," the report said.

Wreckage of the accident airplane was found right of the Runway 18 extended centerline, "with a deviation to the right of about five [degrees] to 10 degrees," the report said. The airplane struck the ground in a nose-low attitude, with the right wing slightly low; the landing gear had been extended, and the flaps had been extended to the approach configuration. Because of impact damage and fire damage, no information was obtained from cockpit instruments or flight control positions.

The report said that damage to the trees in the approach path indicated that the airplane's approach angle had been about 10 [degrees] to 13 degrees.

"The operator estimated that such an approach angle would have required an aircraft attitude of about five degrees nose-down on the aircraft attitude indicator and a rate of descent of about 1,500 [feet per minute] to 2,800 feet per minute, dependent upon indicated airspeed and wind effect," the report said.

At the time of the accident, Mount Gambier airport had a published VOR approach and a published NDB approach, both to Runway 18; GPS approaches to Runway 18 and Runway 36; and a GPS arrival procedure.

Both the VOR approach and the NDB approach and their related circling approaches (extensions of instrument approach procedures that provide for visual circling of the airport before landing) required the aircraft to be flown directly over the airport; witnesses near the airport at the time of the accident said that the airplane was not flown overhead, and the report said that the pilot presumably was not attempting to conduct either a VOR approach or an NDB approach.

Although the Australian Civil Aviation Safety Authority (CASA) had approved the GPS as a nonprecision approach navigation aid under instrument flight rules, the operator said that the airplane was not certified for GPS nonprecision approaches and company pilots were not trained to conduct GPS nonprecision approaches and were not permitted to conduct them. Witnesses on the ground said that they heard the airplane south and west of a GPS Runway 18 waypoint that is 5.3 nautical miles (9.8 kilometers) north of the Runway 18 threshold. The report said that the pilot presumably was not attempting to conduct the GPS nonprecision approach.

Pilot May Have Been Conducting GPS Arrival Procedure

"It was more likely that the pilot was attempting to conduct a GPS arrival procedure, for which he held a qualification," the report said. "The procedure presented a pilot-in-command with two options in accordance with the published instrument approach procedures:

- "Fly overhead the aerodrome and/or the navigation aid and, if visual, conduct a circling approach; [or,]

The Raytheon Beech Super King Air 200C struck the ground 3.1 nautical miles (5.7 kilometers) from Runway 18 at the Mount Gambier airport. (Source: Australian Transport Safety Bureau)

- "Conduct a straight-in approach by tracking to intercept the 360 degree … radial inbound before the final approach fix (five [nautical miles] from the VOR). In this case, the pilot should not descend below 1,200 feet until within five [nautical miles], established on the runway centerline and visually established not below the AT-VASIS [glide path] indication."

Investigators could not determine whether the aircraft was established on the AT-VASIS glide path. If the pilot had allowed the airplane to descend below 1,200 feet before the final approach fix, the airplane would not have been in a position to become established on the AT-VASIS.

At the time of the accident, published procedures for straight-in approaches included requirements for the pilot to broadcast his or her intentions on the MBZ frequency when the aircraft was about 15 nautical miles (28 kilometers) from the airport and about five nautical miles from the airport. The accident pilot did not broadcast his intentions from either location — perhaps because he believed that weather conditions would prevent him from conducting a straight-in approach, the report said.

"The minimum altitudes specified for the Mount Gambier GPS arrival procedure … were 1,900 feet above mean sea level (AMSL) from 13 [nautical miles] to seven [nautical miles; 24 kilometers to 13 kilometers] and 1,200 feet from seven [nautical miles] to two [nautical miles; four kilometers]," the report said. "The minimum descent altitude (MDA) for the procedure, at less than two [nautical miles] was 780 feet. At MDA, the procedure specified a flight visibility requirement of 2.4 kilometers [1.5 statute miles]. The missed approach point was the VOR."

Published procedures for discontinuing an instrument approach or instrument procedure and continuing a descent below MDA required that the pilot fly the aircraft clear of clouds, in sight of ground or water, with flight visibility of at least 5,000 meters (three statute miles), and, within five nautical miles of the airport, aligned with the runway centerline and established "not below on-slope" on the T-VASIS, the report said.

"In addition, when conducting a straight-in approach, a pilot-in-command was required to broadcast on the MBZ frequency at five [nautical miles] that the aircraft was established on final approach at that distance and identifying the runway to be used,' the report said. "There was no evidence on recorded information that the [accident] pilot broadcast that intention."

Radar data recorded by ATS showed that the airplane's descent from cruise altitude began at 2312, when the airplane was about

89 nautical miles (165 kilometers) from Mount Gambier. For the first five minutes, the rate of descent was about 440 feet per minute. Then, when the airplane was about 67 nautical miles (124 kilometers) from Mount Gambier, the descent rate increased to about 1,350 feet per minute for about eight minutes. Radar contact was terminated when the airplane was at 8,200 feet, about 34 nautical miles (63 kilometers) from Mount Gambier. The airplane's groundspeed during the descent was between 237 knots and 269 knots.

"There was no conclusive evidence to indicate why the pilot deviated from published instrument approach procedures," the report said. "In addition, the combination of aircraft attitude and rate of descent during the latter stages of the approach to land could not be explained."

Report Says GPWS Might Have Helped Avert Accident

The report said that the circumstances of the accident "appear to be consistent with controlled flight into terrain.

"Regardless of why the pilot deviated from published instrument approach procedures, he could have still detected and corrected this situation had he been using defenses [that] should have been available to him if they were serviceable."

Post-accident fire damage prevented investigators from determining what decision-height settings had been used for the radio altimeter and altitude-alerting system. If the systems had been functioning properly, with proper settings, aural warnings and voice advisories should have been heard on the CVR; none was heard after the aircraft was flown through 19,700 feet, and the report said that their absence "could not be explained." (The report discussed two possibilities, both of which were described as unlikely. First, the report said that, if the pilot had set the radio altimeter to zero, the radio altimeter's input to the altitude-alerting system would have ceased; a zero setting was not in accordance with standard operating procedures. Second, if the pilot had not changed the altitude selection on the altitude-alert controller from the cruise altitude setting, there would have been no altitude alerts after the airplane had descended more than 1,000 feet below that altitude; such an action also would have made full use of the autopilot impossible.)

The report said that there also was no explanation of why — after the pilot broadcast on the MBZ frequency an estimated arrival time in the circuit area of 2335 — he told ATS at 2333 that he had arrived.

"Based upon estimations of the aircraft's groundspeed, it was likely that he was still about nine [nautical miles; 17 kilometers] from Mount Gambier," the report said. "There was no evidence to indicate why the pilot made this radio transmission at this position."

The report said that, if the airplane had been equipped with a GPWS, the system "may have provided the pilot with a more salient warning to enable him to take corrective action in time to avoid ground contact."

The report said that research has found that 80 percent of fatalities in accidents involving commercial transport aircraft occur in CFIT accidents during the approach-and-landing phase of flight.

The report also cited issues identified by the Flight Safety Foundation (FSF) CFIT Task Force and the FSF Approach-and-landing Accident Reduction (ALAR) Task Force during their evaluations of CFIT and approach-and-landing accidents (ALAs) and their development of accident-prevention recommendations, including the following issues, which were considered especially relevant to this accident:

- "[GPWS] — Given the substantial safety benefits of GPWS, the task force considered that all aircraft in commercial and corporate use, including those involved in domestic operations only, should be equipped with GPWS;

- "Radio altimeter — The task force was convinced of the value of the radio altimeter and believed that the equipment was underutilized as a terrain awareness/avoidance aid in aircraft that are not equipped with GPWS. The task force recommended that procedures should be developed to make greater use of radio altimeters to increase crews' awareness of their aircraft's vertical position;

- "CFIT and … ALAR awareness material — The FSF CFIT Task Force developed a complete CFIT education and prevention package for all members of the aviation community worldwide. The package consisted of a number of safety awareness products, including a 'CFIT Safety Alert,' 'CFIT Checklist' and a number of educational video productions. The checklist was designed to assist aircraft operators in evaluating the CFIT risk for a particular route or flight. It was also useful in highlighting aspects of company operations [that] might be contributing to CFIT risk. … The FSF [ALAR] Task Force also produced [the] *ALAR Tool Kit*, which [includes] an 'Approach-and-landing Risk Reduction Guide.'"[4]

The report said that, although nonprecision approaches can impose a relatively high workload on a single pilot in dark night conditions and reduced visibility, the workload is manageable and an appropriate level of safety can be maintained with "sound preparation for the approach, compliance with published procedures and the effective use of altitude-alerting systems."

The report also cited research by Transport Canada that found that the risk of ALAs increases during approaches that are conducted in "black hole" conditions that exist when airports are isolated from other sources of ground lighting.

"On a dark night, those [airports] necessitate an approach to the runway over dark and generally [unlighted] terrain and can contribute to the pilot experiencing various visual and other sensory illusions," the report said.

During the final minutes of the accident flight, the airplane was flown over dark, unlighted terrain toward lights; weather conditions included low clouds, rain showers and the lack of a defined horizon.

"Flying a visual approach in those conditions has been associated with less reliable pilot control of approach path angle due to the lack of visual cues," the report said. "On occasions, pilots have experienced difficulty judging rates of descent and closure rates, resulting in [their] overestimating approach path angle and flying a shallow approach, sometimes resulting in ground impact short of the [lighted] area. The same conditions can also produce high approaches; however, low approaches have been shown to be more likely."[5]

Accident Prompts Renewed Emphasis on CFIT

As a result of the accident investigation, ATSB said it was again emphasizing to operators the importance of CFIT/ALA awareness. The accident report included as attachments the FSF "CFIT Checklist" (page 8) and the "Approach-and-landing Risk Reduction Guide," one component of the FSF *ALAR Tool Kit* (page 12).

CASA "has encouraged use of the FSF CFIT awareness material and has included CFIT awareness modules in its safety and promotion activities for some time," the report said. Discussion of CFIT was included in one dozen CASA flight safety events attended by nearly 3,000 people in 2002; similar events were held in 2003. In addition, the Aviation Safety Foundation Australia, an affiliate of Flight Safety Foundation, has conducted FSF ALAR courses.

The Airservices Australia *Aeronautical Information Publication, Departure and Approach Procedures (West)*, was amended April 17, 2003, to include a revised GPS arrival chart for Mount Gambier airport. The chart includes procedures for conducting descents earlier than previously allowed to a minimum descent altitude step of two nautical miles. The change "will permit a pilot-in-command more time to achieve a more stable descent profile to the runway," the report said.♦

[FSF editorial note: This article, except where specifically noted, is based on Australian Transport Safety Bureau Aviation Safety Investigation Report BO/200105769, *Raytheon Beech 200C, VH-FMN, Mount Gambier, SA, 10 December 2001*. The 42-page report contains illustrations and appendixes.]

Notes

1. Controlled flight into terrain (CFIT) occurs when an airworthy aircraft under the control of the flight crew is flown unintentionally into terrain, obstacles or water, usually with no prior awareness by the crew. This type of accident can occur during most phases of flight, but CFIT is more common during the approach-and-landing phase, which begins when an airworthy aircraft under the control of the flight crew descends below 5,000 feet above ground level (AGL) with the intention to conduct an approach and ends when the landing is complete or the flight crew flies the aircraft above 5,000 feet AGL en route to another airport.

2. As a result of the investigation of an April 27, 1996, CFIT accident near Alice Springs, West Australia, the Australian Bureau of Air Safety Investigation (which later became part of the new Australian Transport Safety Bureau) recommended that all aircraft engaged in regular public transport or charter category operations be equipped with a ground-proximity warning system (GPWS). The recommendation did not apply to aircraft such as the accident airplane, which was being flown in aerial work category operations.

   Terrain awareness and warning system (TAWS) is the term used by the European Joint Aviation Authorities and the U.S. Federal Aviation Administration to describe equipment meeting International Civil Aviation Organization standards and recommendations for GPWS equipment that provides predictive terrain-hazard warnings; enhanced GPWS and ground collision avoidance system are other terms used to describe TAWS equipment.

3. The abbreviated "T" visual approach slope indicator system (AT-VASIS) consisted of 10 light units on one side of the runway, arranged as "a single wing bar of four light units, with a bisecting longitudinal line of six lights." The Airservices Australia *Aeronautical Information Publication* said that standard installation of an AT-VASIS "aims to provide an obstacle clearance of at least 11 meters [36 feet] above a 1.9-degree slope, within the azimuth splay of 7.5 degrees either side of the runway centerline for a distance of five nautical miles [nine kilometers] from the threshold."

   The publication said that, if an installation differs from the standard, details are published in airport documentation. Published documentation for Mount Gambier airport did not include a statement indicating that the AT-VASIS differed from the standard.

4. Another product of the Flight Safety Foundation CFIT Task Force was the *CFIT Education and Training Aid*, a two-volume package developed under the auspices of the task force and produced in 1997 by the Boeing Commercial Airplanes Group. The *Training Aid* includes an examination of CFIT hazards, specific educational material, a model training program and CFIT-avoidance strategies.

5. The report cited research by The Boeing Co. that found that pilots in "black hole" conditions should "supplement outside visual reference to the runway with airport approach slope indicators or glide path information from navigation instruments, use distance-measuring equipment to fly a three-degree approach angle [and] overfly an unfamiliar [airport] before commencing the approach to landing."

Flight Safety Foundation

CFIT Checklist

Evaluate the Risk and Take Action

Flight Safety Foundation (FSF) designed this controlled-flight-into-terrain (CFIT) risk-assessment safety tool as part of its international program to reduce CFIT accidents, which present the greatest risks to aircraft, crews and passengers. The FSF CFIT Checklist is likely to undergo further developments, but the Foundation believes that the checklist is sufficiently developed to warrant distribution to the worldwide aviation community.

Use the checklist to evaluate specific flight operations and to enhance pilot awareness of the CFIT risk. The checklist is divided into three parts. In each part, numerical values are assigned to a variety of factors that the pilot/operator will use to score his/her own situation and to calculate a numerical total.

In *Part I: CFIT Risk Assessment,* the level of CFIT risk is calculated for each flight, sector or leg. In *Part II: CFIT Risk-reduction Factors,* Company Culture, Flight Standards, Hazard Awareness and Training, and Aircraft Equipment are factors, which are calculated in separate sections. In *Part III: Your CFIT Risk*, the totals of the four sections in *Part II* are combined into a single value (a positive number) and compared with the total (a negative number) in *Part I: CFIT Risk Assessment* to determine your CFIT Risk Score. To score the checklist, use a nonpermanent marker (do not use a ballpoint pen or pencil) and erase with a soft cloth.

Part I: CFIT Risk Assessment

Section 1 – Destination CFIT Risk Factors	Value	Score
Airport and Approach Control Capabilities:		
ATC approach radar with MSAWS	0	_______
ATC minimum radar vectoring charts	0	_______
ATC radar only	-10	_______
ATC radar coverage limited by terrain masking	-15	_______
No radar coverage available (out of service/not installed)	-30	_______
No ATC service	-30	_______
Expected Approach:		
Airport located in or near mountainous terrain	-20	_______
ILS	0	_______
VOR/DME	-15	_______
Nonprecision approach with the approach slope from the FAF to the airport TD shallower than 2 $^3/_4$ degrees	-20	_______
NDB	-30	_______
Visual night "black-hole" approach	-30	_______
Runway Lighting:		
Complete approach lighting system	0	_______
Limited lighting system	-30	_______
Controller/Pilot Language Skills:		
Controllers and pilots speak different primary languages	-20	_______
Controllers' spoken English or ICAO phraseology poor	-20	_______
Pilots' spoken English poor	-20	_______
Departure:		
No published departure procedure	-10	_______
Destination CFIT Risk Factors Total	(−)	_______

Section 2 – Risk Multiplier

	Value	Score
Your Company's Type of Operation (select only one value):		
Scheduled	1.0	_______
Nonscheduled	1.2	_______
Corporate	1.3	_______
Charter	1.5	_______
Business owner/pilot	2.0	_______
Regional	2.0	_______
Freight	2.5	_______
Domestic	1.0	_______
International	3.0	_______
Departure/Arrival Airport (select single highest applicable value):		
Australia/New Zealand	1.0	_______
United States/Canada	1.0	_______
Western Europe	1.3	_______
Middle East	1.1	_______
Southeast Asia	3.0	_______
Euro-Asia (Eastern Europe and Commonwealth of Independent States)	3.0	_______
South America/Caribbean	5.0	_______
Africa	8.0	_______
Weather/Night Conditions (select only one value):		
Night — no moon	2.0	_______
IMC	3.0	_______
Night and IMC	5.0	_______
Crew (select only one value):		
Single-pilot flight crew	1.5	_______
Flight crew duty day at maximum and ending with a night nonprecision approach	1.2	_______
Flight crew crosses five or more time zones	1.2	_______
Third day of multiple time-zone crossings	1.2	_______
Add Multiplier Values to Calculate Risk Multiplier Total		_______
Destination CFIT Risk Factors Total × Risk Multiplier Total = CFIT Risk Factors Total	(−)	_______

Part II: CFIT Risk-reduction Factors

Section 1 – Company Culture

	Value	Score
Corporate/company management:		
Places safety before schedule	20	_______
CEO signs off on flight operations manual	20	_______
Maintains a centralized safety function	20	_______
Fosters reporting of all CFIT incidents without threat of discipline	20	_______
Fosters communication of hazards to others	15	_______
Requires standards for IFR currency and CRM training	15	_______
Places no negative connotation on a diversion or missed approach	20	_______

115-130 points	Tops in company culture
105-115 points	Good, but not the best
80-105 points	Improvement needed
Less than 80 points	High CFIT risk

Company Culture Total (+) _____ *

Section 2 – Flight Standards

Specific procedures are written for:	Value	Score
Reviewing approach or departure procedures charts	10	_______
Reviewing significant terrain along intended approach or departure course	20	_______
Maximizing the use of ATC radar monitoring	10	_______
Ensuring pilot(s) understand that ATC is using radar or radar coverage exists	20	_______
Altitude changes	10	_______
Ensuring checklist is complete before initiation of approach	10	_______
Abbreviated checklist for missed approach	10	_______
Briefing and observing MSA circles on approach charts as part of plate review	10	_______
Checking crossing altitudes at IAF positions	10	_______
Checking crossing altitudes at FAF and glideslope centering	10	_______
Independent verification by PNF of minimum altitude during stepdown DME (VOR/DME or LOC/DME) approach	20	_______
Requiring approach/departure procedure charts with terrain in color, shaded contour formats	20	_______
Radio-altitude setting and light-aural (below MDA) for backup on approach	10	_______
Independent charts for both pilots, with adequate lighting and holders	10	_______
Use of 500-foot altitude call and other enhanced procedures for NPA	10	_______
Ensuring a sterile (free from distraction) cockpit, especially during IMC/night approach or departure	10	_______
Crew rest, duty times and other considerations especially for multiple-time-zone operation	20	_______
Periodic third-party or independent audit of procedures	10	_______
Route and familiarization checks for new pilots		
Domestic	10	_______
International	20	_______
Airport familiarization aids, such as audiovisual aids	10	_______
First officer to fly night or IMC approaches and the captain to monitor the approach-	20	_______
Jump-seat pilot (or engineer or mechanic) to help monitor terrain clearance and the approach in IMC or night conditions	20	_______
Insisting that you fly the way that you train	25	_______

300-335 points	Tops in CFIT flight standards
270-300 points	Good, but not the best
200-270 points	Improvement needed
Less than 200	High CFIT risk

Flight Standards Total (+) _____ *

Section 3 – Hazard Awareness and Training

	Value	Score
Your company reviews training with the training department or training contractor	10	_______
Your company's pilots are reviewed annually about the following:		
Flight standards operating procedures	20	_______
Reasons for and examples of how the procedures can detect a CFIT "trap"	30	_______
Recent and past CFIT incidents/accidents	50	_______
Audiovisual aids to illustrate CFIT traps	50	_______
Minimum altitude definitions for MORA, MOCA, MSA, MEA, etc.	15	_______
You have a trained flight safety officer who rides the jump seat occasionally	25	_______
You have flight safety periodicals that describe and analyze CFIT incidents	10	_______
You have an incident/exceedance review and reporting program	20	_______
Your organization investigates every instance in which minimum terrain clearance has been compromised	20	_______

You annually practice recoveries from terrain with GPWS in the simulator	40	_______
You train the way that you fly	25	_______

285-315 points	Tops in CFIT training		
250-285 points	Good, but not the best	**Hazard Awareness and Training Total**	(+) _____ *
190-250 points	Improvement needed		
Less than 190	High CFIT risk		

Section 4 – Aircraft Equipment

Aircraft includes:

	Value	**Score**
Radio altimeter with cockpit display of full 2,500-foot range — captain only	20	_______
Radio altimeter with cockpit display of full 2,500-foot range — copilot	10	_______
First-generation GPWS	20	_______
Second-generation GPWS or better	30	_______
GPWS with all approved modifications, data tables and service bulletins to reduce false warnings	10	_______
Navigation display and FMS	10	_______
Limited number of automated altitude callouts	10	_______
Radio-altitude automated callouts for nonprecision approach (not heard on ILS approach) and procedure	10	_______
Preselected radio altitudes to provide automated callouts that would not be heard during normal nonprecision approach	10	_______
Barometric altitudes and radio altitudes to give automated "decision" or "minimums" callouts	10	_______
An automated excessive "bank angle" callout	10	_______
Auto flight/vertical speed mode	-10	_______
Auto flight/vertical speed mode with no GPWS	-20	_______
GPS or other long-range navigation equipment to supplement NDB-only approach	15	_______
Terrain-navigation display	20	_______
Ground-mapping radar	10	_______

175-195 points	Excellent equipment to minimize CFIT risk		
155-175 points	Good, but not the best	**Aircraft Equipment Total**	(+) _____ *
115-155 points	Improvement needed		
Less than 115	High CFIT risk		

Company Culture _________ + Flight Standards _________ + Hazard Awareness and Training _________ + Aircraft Equipment _________ = CFIT Risk-reduction Factors Total (+) ________

*** If any section in Part II scores less than "Good," a thorough review is warranted of that aspect of the company's operation.**

Part III: Your CFIT Risk

Part I CFIT Risk Factors Total (–) _____ + **Part II CFIT Risk-reduction Factors Total** (+) _____

= CFIT Risk Score (±) _____

A negative CFIT Risk Score indicates a significant threat; review the sections in Part II and determine what changes and improvements can be made to reduce CFIT risk.

 To request more information or to offer comments about the FSF CFIT Checklist, contact James M. Burin, director of technical programs, Flight Safety Foundation, 601 Madison Street, Suite 300, Alexandria, VA 22314 U.S., Phone: 703-739-6700 • Fax: 703-739-6708.

Flight Safety Foundation

ALAR

Approach-and-landing Accident Reduction

Tool Kit

Approach-and-landing Risk Reduction Guide

The Flight Safety Foundation (FSF) Approach-and-landing Accident Reduction (ALAR) Task Force designed this guide as part of the *FSF ALAR Tool Kit*, which is designed to help prevent ALAs, including those involving controlled flight into terrain. This guide should be used to evaluate specific flight operations and to improve crew awareness of associated risks. This guide is intended for use as a strategic tool (i.e., for long-term planning).

Part 1 of this guide should be used by the chief pilot to review flight operations policies and training. Part 2 should be used by dispatchers and schedulers. The chief pilot should provide Part 3 to flight crews for evaluating pilot understanding of company training objectives and policies. Part 4 should be used by the chief pilot and line pilots.

This guide is presented as a "check-the-box" questionnaire; boxes that are not checked may represent shortcomings and should prompt further assessment.

Part 1 — Operations: Policies and Training

Check the boxes below that apply to your specific flight operations.

Approach

Crew Resource Management

- ❑ Is risk management taught in initial training and recurrent training?
- ❑ Are crew resource management (CRM) roles defined for each crewmember?
- ❑ Are CRM roles defined for each crewmember for emergencies and/or system malfunctions?
- ❑ Are standard operating procedures (SOPs) provided for "sterile-cockpit"[1] operations?
- ❑ Are differences between domestic operations and international operations explained in CRM training?
- ❑ Is decision making taught in CRM training?

Approach Procedures

- ❑ Do detailed and mandatory approach-briefing requirements exist? (See Part 4 below.)
- ❑ Are approach risks among the required briefing items?
- ❑ Are standard calls defined for approach deviations?
- ❑ Are limits defined for approach gate[2] at 1,000 feet in instrument meteorological conditions (IMC) or at 500 feet in visual meteorological conditions (VMC).
- ❑ Is a missed approach/go-around recommended when stabilized approach criteria (Table 1) are exceeded?
- ❑ Is a "no fault" go-around policy established? If so, is it emphasized during training?
- ❑ Does the checklist policy require challenge-and-response for specified items?
- ❑ Does the checklist policy provide for interruptions/distractions?
- ❑ Is a go-around recommended when the appropriate checklist is not completed before reaching the approach gate?

Table 1
Recommended Elements of a Stabilized Approach

All flights must be stabilized by 1,000 feet above airport elevation in instrument meteorological conditions (IMC) and by 500 feet above airport elevation in visual meteorological conditions (VMC). *An approach is stabilized when all of the following criteria are met:*

1. The aircraft is on the correct flight path;
2. Only small changes in heading/pitch are required to maintain the correct flight path;
3. The aircraft speed is not more than V_{REF} + 20 knots indicated airspeed and not less than V_{REF};
4. The aircraft is in the correct landing configuration;
5. Sink rate is no greater than 1,000 feet per minute; if an approach requires a sink rate greater than 1,000 feet per minute, a special briefing should be conducted;
6. Power setting is appropriate for the aircraft configuration and is not below the minimum power for approach as defined by the aircraft operating manual;
7. All briefings and checklists have been conducted;
8. Specific types of approaches are stabilized if they also fulfill the following: instrument landing system (ILS) approaches must be flown within one dot of the glideslope and localizer; a Category II or Category III ILS approach must be flown within the expanded localizer band; during a circling approach, wings should be level on final when the aircraft reaches 300 feet above airport elevation; and,
9. Unique approach procedures or abnormal conditions requiring a deviation from the above elements of a stabilized approach require a special briefing.

An approach that becomes unstabilized below 1,000 feet above airport elevation in IMC or below 500 feet above airport elevation in VMC requires an immediate go-around.

Source: Flight Safety Foundation Approach-and-landing Accident Reduction (ALAR) Task Force (V1.1, November 2000)

- ❑ Are captain/first officer weather limits provided for approach (e.g., visibility, winds and runway conditions)?
- ❑ Are crewmember roles defined for approach (e.g., crewmember assigned pilot flying duties, crewmember monitoring and conducting checklist, crewmember who decides to land or go around, crewmember landing aircraft, exchange of aircraft control)?

Fuel

- ❑ Are fuel minimums defined for proceeding to the alternate airport, contingency fuel, dump-fuel limits?
- ❑ Are crews aware of when to declare "minimum fuel" or an emergency?
- ❑ When declaring an emergency for low fuel, is International Civil Aviation Organization (ICAO) phraseology required (e.g., "Mayday, Mayday, Mayday for low fuel")?

Approach Type

- ❑ Is your risk exposure greatest during precision, nonprecision, circling or visual approaches? Is the training provided appropriate for the risk?
- ❑ Are SOPs provided for constant-angle nonprecision approaches (CANPAs) using rate of descent or angle?

Environment

- ❑ Is training provided for visual illusions on approach (e.g., "black hole effect,"[3] sloping terrain, etc.)?
- ❑ Is training provided for minimum-safe-altitude awareness?
- ❑ Does a policy exist to use the radio altimeter as a terrain-awareness tool?
- ❑ Are crews required to adjust altitudes during approach for lower than international standard atmosphere (ISA) standard temperatures?

- ❑ Are crews aware that most approach-and-landing accidents occur with multiple conditions present (e.g., rain and darkness, rain and crosswind)?

Airport and Air Traffic Control (ATC) Services

- ❑ Are crews aware of the increased risk at airports without radar service, approach control service or tower service?
- ❑ Is training provided for unfamiliar airports using a route check or a video?
- ❑ Is potential complacency at very familiar airports discussed?
- ❑ Are crews provided current weather at destination airfields via automatic terminal information service (ATIS), airborne communications addressing and reporting system (ACARS) and/or routine weather broadcasts for aircraft in flight (VOLMET)?

Aircraft Equipment

- ❑ Are procedures established to evaluate the accuracy and reliability of navigation/terrain databases?
- ❑ Are mechanical checklists or electronic checklists installed?
- ❑ Is a radio altimeter installed in the pilot's normal scan pattern?
- ❑ Does the radio altimeter provide visual/audio alerting?
- ❑ Is a wind shear alert system (either predictive or reactive) installed?
- ❑ Is a ground-proximity warning system (GPWS) or a terrain awareness and warning system (TAWS)[4] installed?
- ❑ Is a traffic-alert and collision avoidance system (TCAS) installed?
- ❑ Are head-up displays (HUDs) installed with a velocity-vector indicators?
- ❑ Are angle-of-attack indicators installed?
- ❑ For aircraft with a flight management system (FMS), are lateral navigation/vertical navigation (LNAV/VNAV) approach procedures database-selected?
- ❑ Are pilots prevented from modifying specified FMS data points on approach?
- ❑ Is the FMS system "sole-means-of-navigation" capable?
- ❑ Is there a policy for appropriate automation use (e.g., "full up for Category III instrument landing system, okay to turn automation off for a daylight visual approach")?
- ❑ Is there a policy requiring standard calls by the pilot not flying for mode changes and annunciations on the mode control panel?
- ❑ Is training provided and are policies established for the use of all the equipment installed on all aircraft?
- ❑ Are current and regulator-approved navigation charts provided for each flight crewmember?

Flight Crew

- ❑ Is there a crew-pairing policy established for new captain/new first officer based on flight time or a minimum number of trip segments?
- ❑ Is the check airmen/training captain program monitored for feedback from pilots? Are additional training needs, failure rates and complaints about pilots from line operations tracked? Is it possible to trace these issues to the check airmen/training captain who trained specific pilots?
- ❑ Is there a hazard reporting system such as a captain's report? Are policies established to identify and to correct problems? Is a system set up to provide feedback to the person who reports a hazard?

Safety Programs

- ❑ Is a nonpunitive safety reporting system established?
- ❑ Is a proactive safety monitoring program such as a flight operational quality assurance (FOQA) program or an aviation safety action program (ASAP) established?

Landing

- ❑ Is training provided and are policies established for the use of visual landing aids?
- ❑ Is it recommended that crews use all available vertical guidance for approaches, especially at night?
- ❑ Is training provided and are policies established for landing on contaminated runways with adverse winds?
- ❑ Are crews knowledgeable of the differences in braking deceleration on contaminated runways and dry runways?
- ❑ Does training include performance considerations for items such as critical touchdown area, braking required, land-and-hold-short operation (LAHSO), engine-out go-around, and full-flaps/gear-extended go-around?
- ❑ Does the aircraft operating manual (AOM)/quick reference handbook (QRH) provide crosswind limitations?
- ❑ Is a policy in effect to ensure speed brake deployment and autobrake awareness?
- ❑ Does policy prohibit a go-around after reverse thrust is selected?

Part 2 — Dispatcher/Scheduler

Check the boxes below that apply to your specific flight operations.

- ❑ Does the company have a dispatch system to provide information to assist flight crews in evaluating approach-and-landing risks?

Approach and Landing

- ❑ Are dispatchers and captains familiar with each other's authority, accountability and responsibility?
- ❑ Are crews monitored for route qualifications and appropriate crew pairing?
- ❑ Are crew rest requirements defined adequately?
- ❑ Does the company monitor and provide suitable crew rest as defined by requirements?
- ❑ Are crews provided with timely and accurate aircraft performance data?
- ❑ Are crews assisted in dealing with minimum equipment list(MEL)/dispatch deviation guide (DDG)/ configuration deviation list (CDL) items?
- ❑ Do dispatch-pilot communications exist for monitoring and advising crews en route about changing conditions?
- ❑ Are updates provided on weather conditions (e.g., icing, turbulence, wind shear, severe weather)?
- ❑ Are updates provided on field conditions (e.g., runway/taxiway conditions, braking-action reports)?
- ❑ Is there coordination with the captain to determine appropriate loads and fuel required for the effects of ATC flow control, weather and alternates?
- ❑ Are all the appropriate charts provided for routing and approaches to destinations and alternates?
- ❑ Is a current notice to airmen (NOTAM) file maintained for all of your operations and is the appropriate information provided to crews?

Part 3 — Flight Crew

Check the boxes below that apply to your specific flight operations.

- ❑ Do you believe that you have appropriate written guidance, training and procedures to evaluate and reduce approach-and-landing risks?

Approach

- ❑ Is the Flight Safety Foundation *Approach-and-landing Risk Awareness Tool* (*RAT*) provided to flight crews, and is its use required before every approach?
- ❑ Does the approach briefing consist of more than the "briefing strip" minimum? (See Part 4 below.)

- ❑ Do briefings include information about visual illusions during approach and methods to counteract them?
- ❑ Are the following briefed: setup of the FMS, autopilot, HUD, navigation radios and missed approach procedures?
- ❑ Is a discussion of missed approach/go-around details required during every approach briefing?
- ❑ Are performance minimums briefed for the approach gate?
- ❑ Are standard calls required for deviations from a stabilized approach?
- ❑ Does the briefing include execution of a missed approach/go-around if criteria for the approach gate are not met?
- ❑ Are stabilized approach criteria defined? Is a go-around recommended in the event that these criteria are not met?
- ❑ Does your company practice a no-fault go-around policy?
- ❑ Are you required to write a report to the chief pilot if you conduct a missed approach/go-around?
- ❑ Do you back up the flight plan top-of-descent point with your own calculation to monitor descent profile?
- ❑ Are approach charts current and readily available for reference during approach?
- ❑ Are policies established to determine which crewmember is assigned pilot flying duties, which crewmember is assigned checklist duties, which crewmember will land the aircraft and how to exchange aircraft control? Do these policies change based on prevailing weather?
- ❑ Do terrain-awareness procedures exist (e.g., calling "radio altimeter alive," checking radio altimeter altitudes during approach to confirm that the aircraft is above required obstacle clearance heights)?
- ❑ Do altitude-deviation-prevention policies exist (e.g., assigned altitude, minimum descent altitude/height [MDA(H)], decision altitude/height [DA(H)])?
- ❑ Are you familiar with the required obstacle clearance criteria for charting design?
- ❑ Do altimeter-setting procedures and cross-check procedures exist?
- ❑ Do temperature-compensation procedures exist for temperatures lower than ISA at the destination airport?
- ❑ Are you aware of the increased risk during night/low-visibility approaches when approach lighting/visual approach slope indicator/precision approach path indicator aids are not available? How do you compensate for these deficiencies? For example, are runways with vertical guidance requested in those conditions?
- ❑ Are you aware of the increased risk associated with nonprecision approaches compared with precision approaches?
- ❑ Is a CANPA policy established at your company? Are you aware of the increased risk associated with step-down approaches compared with constant-angle approaches?
- ❑ Is a policy established for maintaining visual look-out, and is there a requirement to call "head-down"?
- ❑ Does a look-out policy exist for approach and landing in visual flight rules (VFR) conditions?

Part 4 — Recommended Approach-and-landing Briefing Items

For the approach-risk briefing, refer to top-of-descent use of the FSF *Approach-and-landing RAT*.

In addition to the briefing strip items (e.g., chart date, runway, approach type, glideslope angle, check altitudes), which of following items are briefed, as appropriate?

- ❑ Automation setup and usage
- ❑ Navigation equipment setup and monitoring
- ❑ Rate of descent/angle of descent
- ❑ Intermediate altitudes and standard calls

- ❑ Altitude-alert setting and acknowledgment
- ❑ MDA(H)/DA(H) calls (e.g., “landing, continue, go-around”); runway environment expected to see (offsets); lighting
- ❑ Radio-altimeter setting in the DH window, calls required (e.g., “radio altimeter alive” and “below 1,000 feet” prior to an intermediate approach fix; “below 500 feet” prior to the final approach fix [FAF]; “go around” after the FAF if “minimums” is called [with radio altimeter at 200 feet] and if visual contact with the required references is not acquired or the aircraft is not in position for a normal landing)
- ❑ Aircraft configuration
- ❑ Airspeeds
- ❑ Checklists complete
- ❑ ATC clearance
- ❑ Uncontrolled airport procedures
- ❑ Manual landing or autoland
- ❑ Missed approach procedure/go-around
- ❑ Performance data
- ❑ Contaminated runway/braking action and autobrakes
- ❑ Illusions/hazards or other airport-specific items
- ❑ Abnormals (e.g., aircraft equipment/ground facilities unserviceable, MEL/DDG items, glideslope out)
- ❑ Runway (e.g., length, width, lighting, LAHSO, planned taxiway exit)
- ❑ Procedure for simultaneous approaches (as applicable)

References

1. The *sterile cockpit rule* refers to U.S. Federal Aviation Regulations Part 121.542, which states: “No flight crewmember may engage in, nor may any pilot-in-command permit, any activity during a critical phase of flight which could distract any flight crewmember from the performance of his or her duties or which could interfere in any way with the proper conduct of those duties. Activities such as eating meals, engaging in nonessential conversations within the cockpit and nonessential communications between the cabin and cockpit crews, and reading publications not related to the proper conduct of the flight are not required for the safe operation of the aircraft. For the purposes of this section, critical phases of flight include all ground operations involving taxi, takeoff and landing, and all other flight operations below 10,000 feet, except cruise flight.” [The FSF ALAR Task Force says that “10,000 feet” should be height above ground level during flight operations over high terrain.]
2. The Flight Safety Foundation Approach-and-landing Accident Reduction (ALAR) Task Force defines *approach gate* as “a point in space (1,000 feet above airport elevation in instrument meteorological conditions or 500 feet above airport elevation in visual meteorological conditions) at which a go-around is required if the aircraft does not meet defined stabilized approach criteria.”
3. The *black-hole effect* typically occurs during a visual approach conducted on a moonless or overcast night, over water or over dark, featureless terrain where the only visual stimuli are lights on and/or near the airport. The absence of visual references in the pilot’s near vision affect depth perception and cause the illusion that the airport is closer than it actually is and, thus, that the aircraft is too high. The pilot may respond to this illusion by conducting an approach below the correct flight path (i.e., a low approach).
4. Terrain awareness and warning system (TAWS) is the term used by the European Joint Aviation Authorities and the U.S. Federal Aviation Administration to describe equipment meeting International Civil Aviation Organization standards and recommendations for ground-proximity warning system (GPWS) equipment that provides predictive terrain-hazard warnings. “Enhanced GPWS” and “ground collision avoidance system” are other terms used to describe TAWS equipment.

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ALAR

Approach-and-landing Accident Reduction

Tool Kit

The Flight Safety Foundation *ALAR Tool Kit* is a comprehensive and practical resource on compact disc to help you prevent the leading causes of fatalities in commercial aviation: approach-and-landing accidents (ALAs), including those involving controlled flight into terrain (CFIT).

Put the FSF *ALAR Tool Kit* to work for you TODAY!

- Separate lifesaving facts from fiction among the data that confirm ALAs and CFIT are the leading killers in aviation. Use FSF data-driven studies to reveal eye-opening facts that are the nuts and bolts of the FSF *ALAR Tool Kit*.
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- Print in six different languages the widely acclaimed FSF *CFIT Checklist*, which has been adapted by users for everything from checking routes to evaluating airports. This proven tool will enhance CFIT awareness in any flight department.
- Five ready-to-use slide presentations — with speakers' notes — can help spread the safety message to a group, and enhance self-development. They cover ATC communication, flight operations, CFIT prevention, ALA data and ATC/aircraft equipment. Customize them with your own notes.
- *An approach and landing accident: It could happen to you!* This 19-minute video can help enhance safety for every pilot — from student to professional — in the approach-and-landing environment.
- *CFIT Awareness and Prevention*: This 33-minute video includes a sobering description of ALAs/CFIT. And listening to the crews' words and watching the accidents unfold with graphic depictions will imprint an unforgettable lesson for every pilot and every air traffic controller who sees this video.
- Many more tools — including posters, the FSF *Approach-and-landing Risk Awareness Tool* and the FSF *Approach-and-landing Risk Reduction Guide* — are among the more than 590 megabytes of information in the FSF *ALAR Tool Kit*. An easy-to-navigate menu and bookmarks make the FSF *ALAR Tool Kit* user-friendly. Applications to view the slide presentations, videos and publications are included on the CD, which is designed to operate with Microsoft Windows or Apple Macintosh operating systems.

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- Windows 95/98/NT/ME/2000/XP system software
- A Sound Blaster® or compatible sound card and speakers
- DirectX® version 3.0 or later recommended

Mac® OS

- A PowerPC processor-based Macintosh computer
- At least 32MB of RAM
- Mac OS 7.5.5 or later

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Accident Prevention

 ISSN 1057-5561

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