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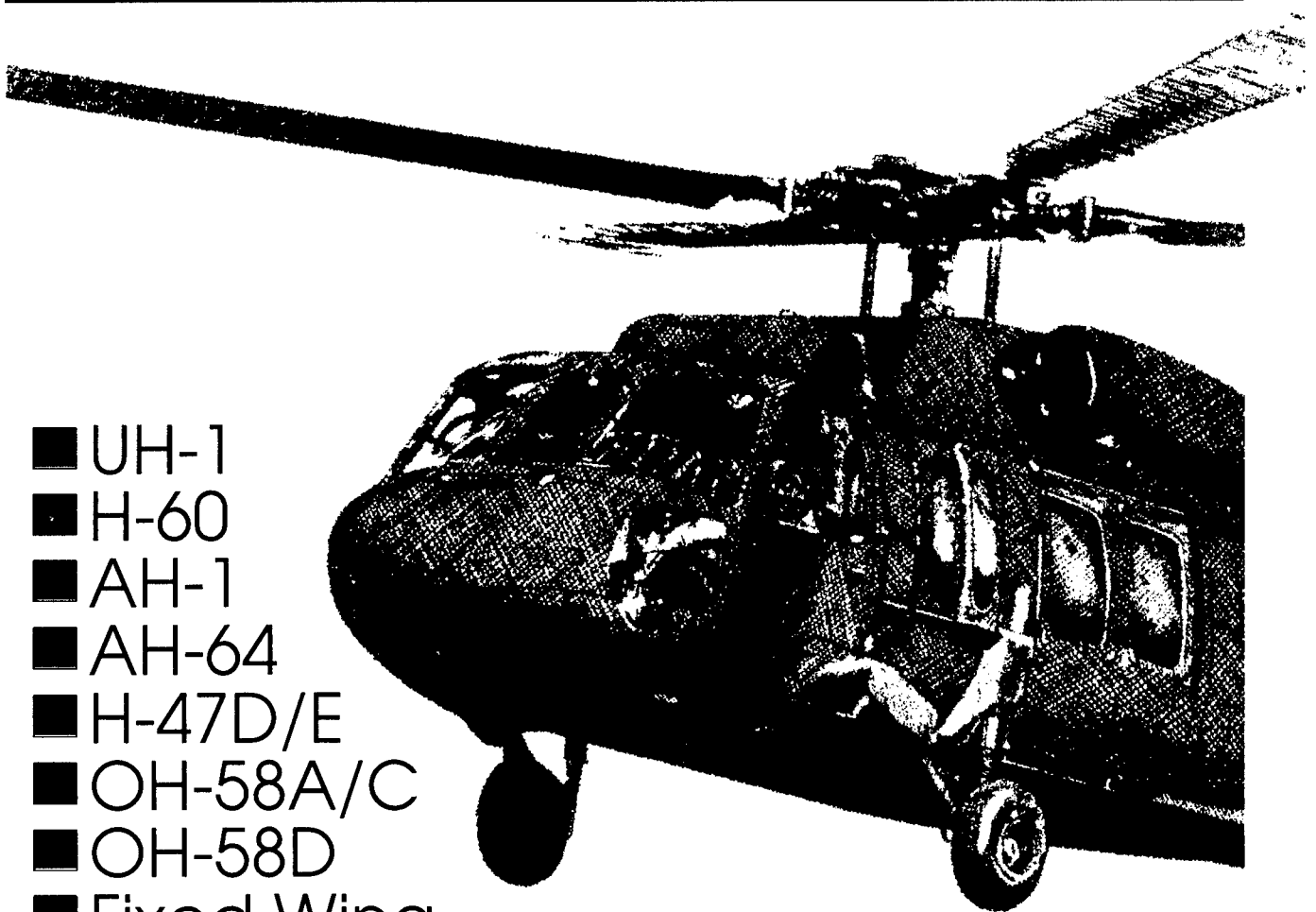
December 1993

Army Aircraft Safety Performance

REVIEW

- FY 89 through FY 93 -

- UH-1
- H-60
- AH-1
- AH-64
- H-47D/E
- OH-58A/C
- OH-58D
- Fixed Wing



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Foreword

In every operation—whether training, combat, or humanitarian assistance—force protection is essential to success. Statistics show that during such operations soldiers are more likely to be killed or injured from accidents than from any other cause. In World War II, 56 percent of the casualties were from accidents; in Korea, it was 44 percent; in Vietnam, it was 55 percent; and in Desert Shield/Storm, it was an alarming 75 percent. This represents a serious loss in combat power and in our ability to accomplish our mission.

Accidents cause a serious drain on operational assets at a time when we can least afford to lose them. It is imperative that force protection be integrated into every mission and at every level. To do this, leaders must continually monitor the readiness of their soldiers and equipment, as well as the status of training and logistical support.

We must use the risk-management process to identify and control hazards before they can cause an accident. This is more than the risk-assessment sheet you complete before a flight. It is a systematic process of identifying and assessing hazards and applying control measures to enhance training and mission accomplishment and preserve the force.

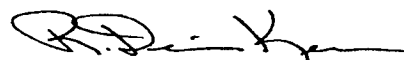
Human error normally accounts for about 80 percent of all accidents. Poor crew coordination accounts for the largest percentage of human error-failures. Herein lies our greatest challenge and the area in which we can have the greatest impact on force protection.

This report was prepared to provide aviation commanders, safety officers, aircrews, and maintenance personnel an overview of utility, attack, cargo, observation, and fixed wing aircraft safety performance for fiscal years 89 through 93. With the help of the Army Aviation Center Directorate of Evaluation and Standardization and the Aviation Training Brigade at Fort Rucker, AL, we have provided some aviation prevention techniques and procedures and control measures that may help you enhance realistic training while reducing human error, thus increasing force protection.

This report is in nine sections. Section I describes overall Army aviation experience. Sections II through IX provide overviews of the accident experience of each aircraft system, along with synopses of selected accidents and accident-prevention measures. Note that these synopses do not necessarily reflect all factors contributing to the accident; they concentrate on the primary cause or risk management failure.

I hope this document will be a useful tool for you. If you have comments or suggestions, please send them to Commander, U.S. Army Safety Center, ATTN; CSSC-PMA, Fort Rucker, AL 36362-5363.

Please join us in an effort to make FY 94 the safest and most productive year ever in Army aviation.



R. DENNIS KERR
Brigadier General, GS
Director of Army Safety

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Section I

Armywide Aviation Experience

During the 5-year period of fiscal years 89 through 93, the Army experienced 159 Class A accidents, 57 Class B accidents, and 405 Class C accidents. Figures 1-1 through 1-4 display Armywide performance during this period. The DOD accident classification criteria are shown in table 1-1.

These accidents resulted in the destruction of 151 aircraft. There were 154 fatalities and 155

injuries to Army personnel. Damage costs exceeded \$594 million and injury costs exceeded \$375 million, for a total loss to the Army of more than \$969 million. These losses roughly equate to losing the personnel of 2.5 aviation battalions and the aircraft of 1.5 aviation brigades.

The cumulative Class A and A-C accident rates for fiscal years 89 through 93 were 2.15 and 8.41 respectively per 100,000 flight hours based on an overall Army total of 7,382,453 hours flown.

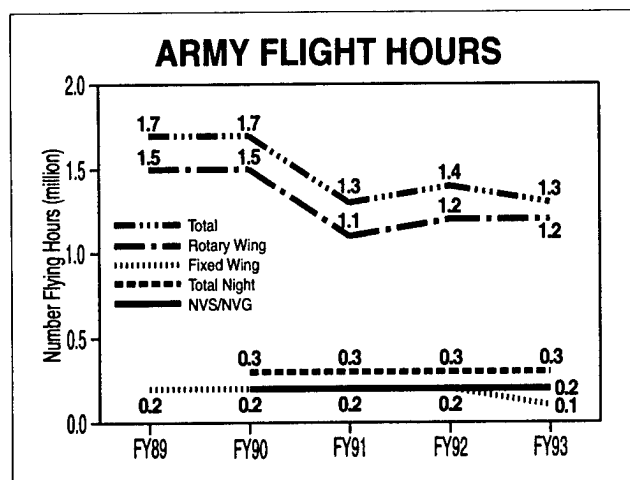


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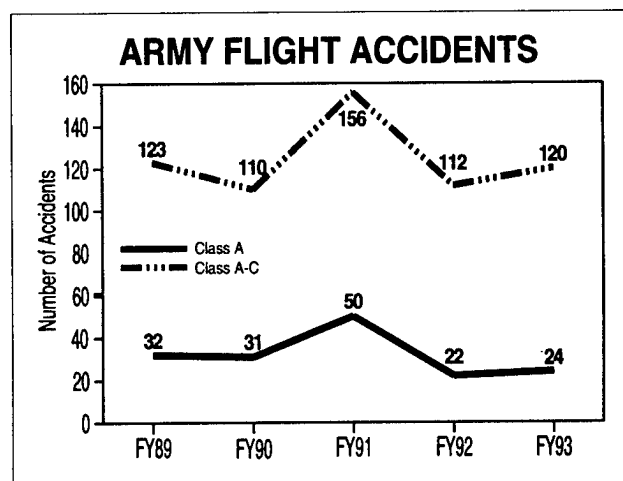


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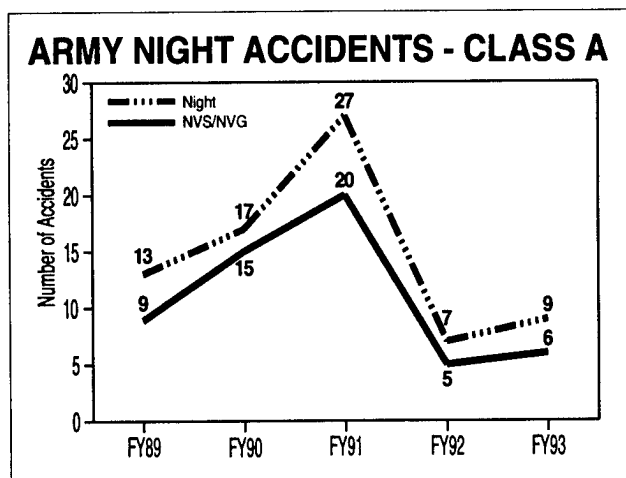


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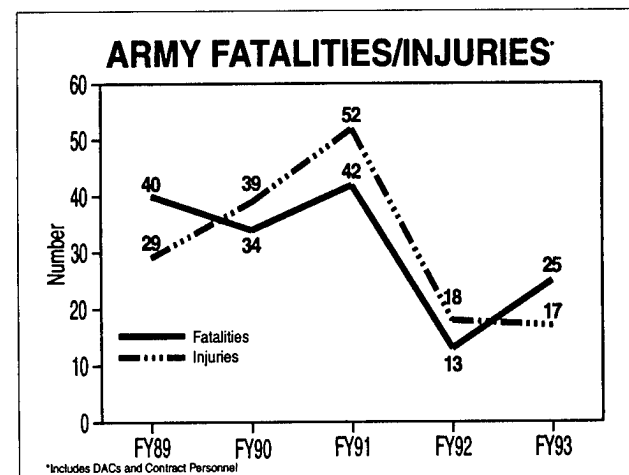


Figure 1-4

*Includes DACs and Contract Personnel

Notes:

1. All accident data in this publication is based on aviation flight accidents.
2. Flying hours and rates for FY 93 are estimated.
3. All accident data is based on reports received by USASC as of 30 September 1993.
4. Each accident may have more than one cause factor; therefore, total cause factors may not equal the number of Class As.

Human error

An analysis of fiscal years 89 through 93 Army aviation Class A-C flight accidents revealed human error was still the leading cause factor. Human error accounted for more than 70 percent of our accidents and was responsible for 119 fatalities, 155 injuries, and more than \$518 million in losses.

A review of the particular errors that caused or contributed to accidents indicated that failing to follow procedures (for example, taking shortcuts), was the most frequently occurring failure. The second most prevalent error was crew-

members displaying a lack of attention or misdirecting their attention (for example, channelizing their attention). The third and fourth most prevalent errors were inadequate inspection/search (for example, during preflight) and misinterpreting an emergency situation, materiel failure/malfunction.

As table 1-2 indicates, the most frequently occurring source of these errors was individual failure (49 percent). Crewmembers know and are trained to standard but elect not to follow standards because of a lack of self-discipline, haste, or overconfidence in themselves, other crewmembers, or the capability of the aircraft.

Army aviation can overcome these shortcomings by employing solid **risk-management** practices. The emphasis is on management. Commanders and crews can have a direct effect on aviation safety by taking responsibility for the known mission hazards, developing and implementing controls to mitigate the risks associated with these hazards, and then supervising the controls. Crewmembers must rely on each other to identify new hazards that develop during the

Table 1.1 Accident classification criteria

Class A accident The resulting total cost of reportable damage is \$1 million or more; a DOD aircraft is destroyed; or an injury and/or occupational illness results in a fatality or permanent total disability.
Class B accident The resulting total cost of reportable property damage is \$200,000 or more, but less than \$1 million; an injury and/or occupational illness results in permanent partial disability; or five or more personnel are hospitalized.
Class C accident The resulting total cost of property damage is \$10,000 or more, but less than \$200,000; a nonfatal injury that causes any loss of time from work beyond the day or shift on which it occurred; or a nonfatal illness or disability that causes loss of time from work or disability at any time (lost-time case).
Class D accident The resulting total cost of property damage is \$2,000 or more but less than \$10,000, or a nonfatal injury that does not meet the criteria of a Class C mishap (no-lost-time case).
Class E incident The resulting cost of property damage is less than \$2,000. AR 385-40: Accident Reporting and Records, paragraph 4-6e, defines Class E incidents in detail.
FOD incident Reportable incidents confined to turbine engine damage as a result of internal or external turbine engine foreign object damage (FOD). FOD incidents are to be reported on a PRAM as an "FOD incident" regardless of cost.

Note: Classification is based solely on property damage or injury/illness severity (fatal, permanent partial disability, etc.), not injury cost.

mission, assess the risks, and develop contingency controls for these events. The addition of crew coordination procedures in the aircrew training manuals and development and fielding

of the Crew Coordination Exportable Training Package by the Army Aviation Center should provide aircrews with the tools they need to safely accomplish the mission.

Table 1-2. Sources of human error

Source	Readiness Shortcoming
Individual (49%)	Soldier knows and is trained to standard but elects not to follow standard (self-discipline).
Training (23%)	Soldier is not trained to known standard (insufficient, incorrect, or no training on task).
Support (13%)	Equipment or materiel is improperly designed or not provided; insufficient number or type of personnel; inadequate maintenance, facilities, or services.
Standards (8%)	Standards or procedures are not clear or practical or do not exist.
Leader (7%)	Leader does not enforce known standard.

Section II

UH-1 Safety Performance Review

The UH-1 was involved in 34 Class A accidents, 5 Class B accidents, and 85 Class C accidents during the FY 89 through FY 93 time period. These accidents resulted in 51 fatalities and 30 injuries. The UH-1 cumulative Class A and A-C accident rates for the period were 1.22 and 4.44 respectively per 100,000 flight hours based on a total of 2,790,093 hours, compared to the total rotary wing cumulative Class A and A-C rates of 2.28 and 8.61.

The leading cause of UH-1 accidents continues to be human error. Findings in the 28 Class A human error accidents were distributed as fol-

lows: 33 individual failures, 3 standards failures, 24 training failures, 7 leader failures, and 1 support failure. (Remember that each accident may have more than one cause factor.)

Materiel failure accounted for 8 of the 34 Class A accidents and 2 occurred as a result of environmental factors.

Accident experience

Figures 2-1 through 2-4 depict UH-1 trends over the 5-year period. Note that trends may appear skewed in FY 91 due to Operations Desert Shield/Storm.

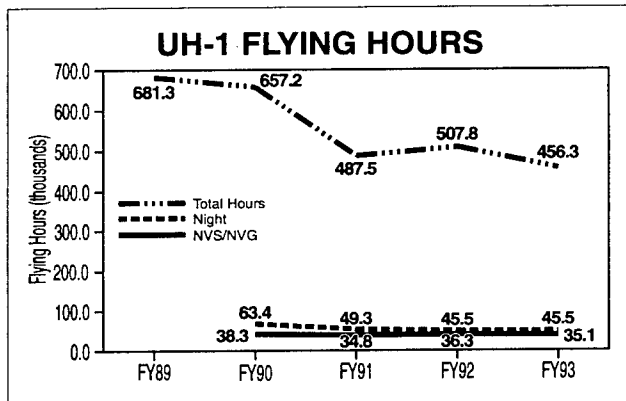


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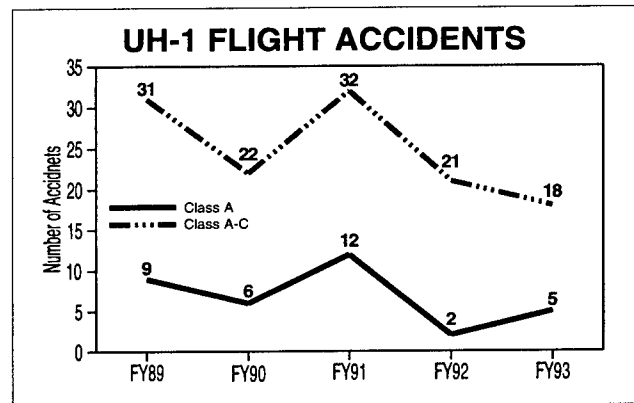


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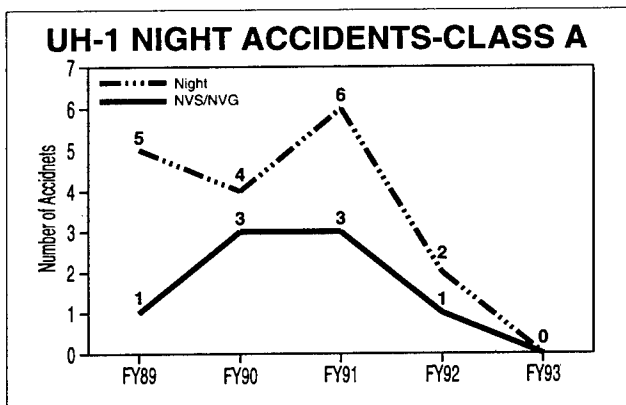


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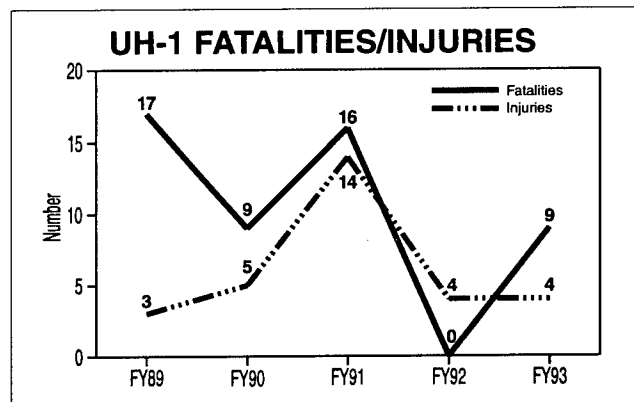


Figure 2-4

Selected accident briefs

Analysis of Class A-C UH-1 accidents from FY 89 through FY 93 identified the following as the three types of accidents occurring most frequently:

- Collision with ground or water
- Engine failure
- IMC accidents

Collision with ground or water

Scenario 1. During a day NOE training mission, the main rotor blades struck the edge of an earthen berm. After repeated blade strikes with the ground, the fuselage impacted the ground, pivoted on its nose, and came to rest in a small gully. Postcrash fire consumed the major portion of the aircraft.



■ **Result:** Two fatalities, a destroyed aircraft, and a cost of \$3,122,704.

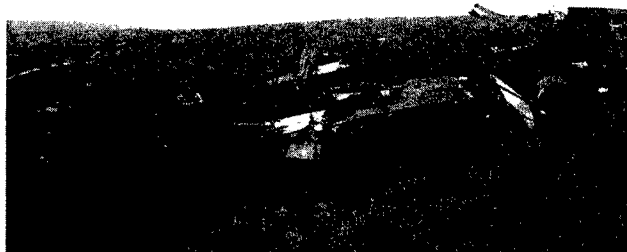
■ **Cause:** The crew failed to follow the general rules and principles for terrain flight found in TC 1-211: ATM Utility Helicopter, UH-1; TC 1-201: Tactical Flight Procedures; and the operators manual.

■ **Crew experience:** The PC had 743 hours of flight time, all of them in UH-1s. The PI had 738 hours of flight time, all of them in UH-1s.

Prevention techniques and procedures: While aircrew training manuals do not provide maximum airspeeds for day terrain flight operations, all crewmembers must understand the danger of flying too fast and too low. In a training or combat environment, operating very fast and low may be necessary for very short periods; e.g., a dash across an open area, but that flight regime must be

reserved for special circumstances. At very fast airspeeds and low altitudes, even a second's distraction can be fatal.

Scenario 2. During an NVG formation training mission, a flight of four aircraft encountered unforecast marginal weather conditions consisting of low ceiling and restricted visibility due to precipitation. Subsequently, the crew of the trail aircraft lost visual outside reference. The aircraft was allowed to descend and impact the ground in a level attitude.



■ **Result:** Three injuries, a destroyed aircraft, and a cost of \$937,932.

■ **Cause:** The UT at the controls failed to follow written procedures. When outside visual reference was lost due to weather conditions, the UT leveled the aircraft but failed to add power to establish a climb as prescribed in TC 1-211.

■ **Crew experience:** The UT had 3,571 hours of flight time, 806 in UH-1s. The PI had 260 hours of flight time, all of them in UH-1s.

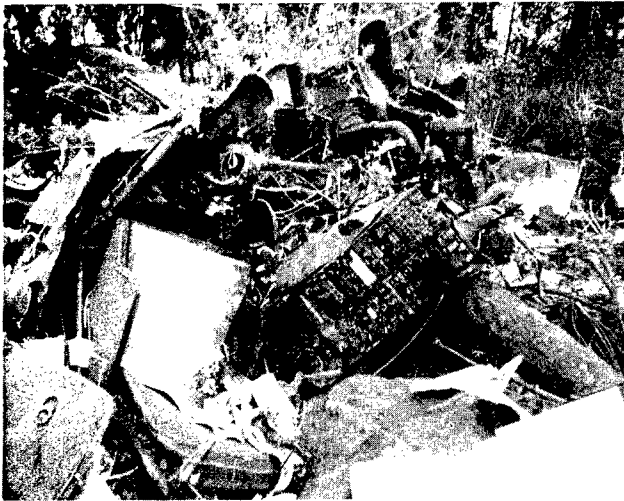
Prevention techniques and procedures: Task 1083: Perform or Describe VHIRP in TC 1-211 describes what to do if inadvertent IMC is encountered.

Engine failure

Scenario 1. Aircraft departed a 6,700-foot mountain peak and was observed to yaw excessively while on climbout. The aircraft then crashed unobserved, 700 feet down the slope. The aircraft and crew were not found until the next day.

■ **Result:** Three fatalities, one injury, a destroyed aircraft, and a cost of \$3,441,448.

■ **Cause:** Suspect partial or complete engine failure based on evidence presented by the



surviving crewmember. Pilots had indicated they were having a problem, and he had observed a rapid decrease in rotor and engine RPM. The surviving crewmember was not located until the next day because—

- The command had decided that it was unnecessary to have flight following for a single aircraft with an IP on board.

- Only one crewmember had a survival radio even though the unit had an ample supply of radios and AR 95-3: Aviation: General Provisions, Training, Standardization, and Resource Management requires that all crewmembers have survival radios if they are available.

- The aircraft did not have an emergency locator transmitter (ELT) on board, although the unit had ELTs on hand.

■ **Crew experience:** The IP had 5,335 hours of flight time, 3,730 in UH-1s. The PI had 3,549 hours of flight time, 433 in UH-1s.

Prevention techniques and procedures: The tear-down analysis could not determine the cause of engine failure in this case. CCAD will continue analyzing crash-damaged components for failure. Commands need to recognize the importance of flight following on single-ship missions, especially if the aircraft has no ELT installed or minimal survival radio availability has been waived. ELTs are not required by Army regulation, but they should be on board aircraft when they are authorized and available. If units have ample supplies of survival radios, they should be issued to all crewmembers as required by AR 95-3. Quick rescue can save lives.

Scenario 2. The crew was on a return flight to base camp, under NVDs. On approach, the aircraft experienced several compressor stalls. The PC elected to shoot a shallow approach with minimum power to the ground. As the aircraft was about to touch down, the engine failed. The aircraft yawed left, the right skid contacted the ground, and the aircraft rolled over, coming to rest on its side.



■ **Result:** A destroyed aircraft and a cost of \$925,529.

■ **Cause:** Aircraft had been flown in a desert environment for a period of 60 days, sustaining sand erosion to the internal components of the engine and subsequently causing the engine to lose power and fail.

■ **Crew experience:** The PC had 1,652 hours of flight time, number of hours in UH-1s is unknown. The PI had 536 hours of flight time, number of hours in UH-1s is unknown.

Prevention techniques and procedures: Although it is hard to predict when an engine will fail, pilots should consider all engine compressor stalls as a warning of impending engine failure and be prepared to land without power. Frequent engine flushes should be performed on aircraft operating in sandy environments.

IMC accidents

Scenario 1. During a night transport mission over hilly jungle terrain, PI flew into a rainstorm and lost visual reference with the ground. He attempted IMC recovery procedures, lost control of the aircraft, and crashed.



■ **Result:** Nine fatalities, a destroyed aircraft, and a cost of \$4,354,124.

■ **Cause:** The PI elected to fly into the rainshower because of overconfidence in his abilities to handle inadvertent IMC and a strong personal desire to respond to radio calls that led him to believe another aircraft had just crashed.

■ **Crew experience:** The PC had 543 hours of flight time, 539 in UH-1s. The PI had 399 hours of flight time, all of them in UH-1s.

Prevention techniques and procedures: Frequently practice inadvertent IMC recovery procedures. The biggest mistake aviators make is trying to regain visual contact with the ground. When encountering IMC, commit to instrument flight. Concentrate on the basic flight tasks one step at a

time. Do not attempt to do too much at one time. Strive for "excellent" instrument proficiency, not just adequate. Ensure aviators conduct their own risk assessment before attempting unplanned missions.

Scenario 2. While flying low level at night, over water, at an estimated cruise airspeed of 100 knots, the aircraft entered an area of deteriorating weather and reduced visibility. The aircraft descended in a left-bank attitude, impacted the water at a high speed, and sank in 220 feet of water.

■ **Result:** Three fatalities, a destroyed aircraft, and a cost of \$3,426,192.

■ **Cause:** The crew failed to arrest the descent because of inadequate attention and/or spatial disorientation under IMC conditions.

■ **Crew experience:** The PC had 2,670 hours of flight time, 2,592 in UH-1s. The PI had 1,507 hours of flight time, all of them in UH-1s.

Prevention techniques and procedures. Frequently practice inadvertent IMC recovery procedures. Aviators should strive for proficiency in vertical helicopter instrument recovery procedures (VHIRP)/IMC recovery, utilizing the simulator.

Section III

H-60 Safety Performance Review

The H-60 was involved in 15 Class A accidents, 16 Class B accidents, and 63 Class C accidents during the FY 89 through FY 93 time period. These accidents resulted in 35 fatalities and 51 injuries. The H-60 cumulative Class A and A-C accident rates for the period were 1.70 and 10.68 respectively per 100,000 flight hours based on a total of 880,494 hours, compared to the total rotary wing cumulative Class A and A-C rates of 2.28 and 8.61.

The leading cause of H-60 accidents continues to be human error. Findings in the 11 Class A human error accidents were distributed as fol-

lows: 15 individual failures, 6 standards failures, 9 training failures, 9 leader failures, and 2 support failures. (Remember that each accident may have more than one cause factor.)

Materiel failure accounted for 4 of the 15 Class A accidents and 2 occurred as a result of environmental factors.

Accident experience

Figures 3-1 through 3-4 depict H-60 trends over the 5-year period. Note that trends may appear skewed in FY 91 due to Operations Desert Shield/Storm.

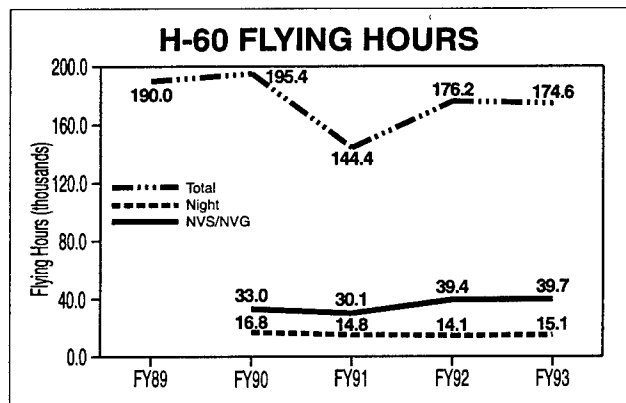


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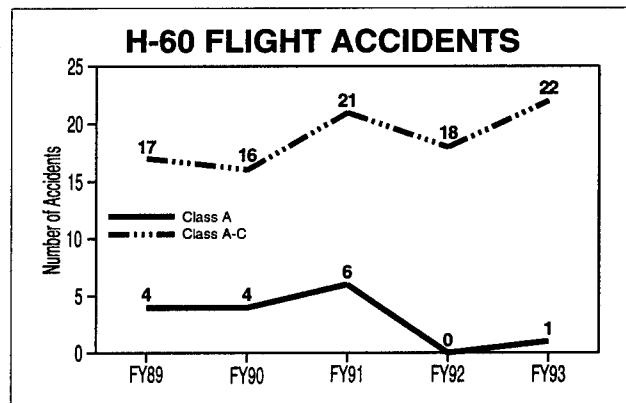


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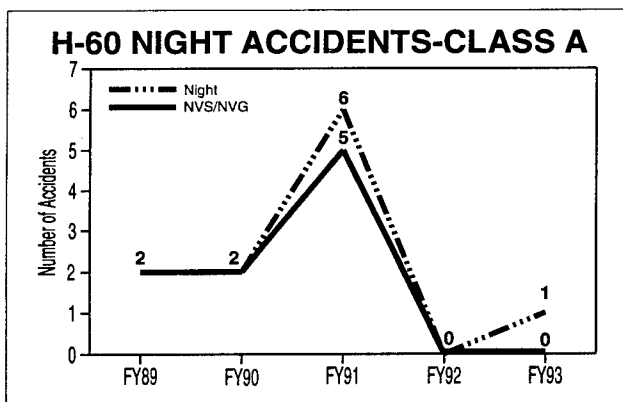


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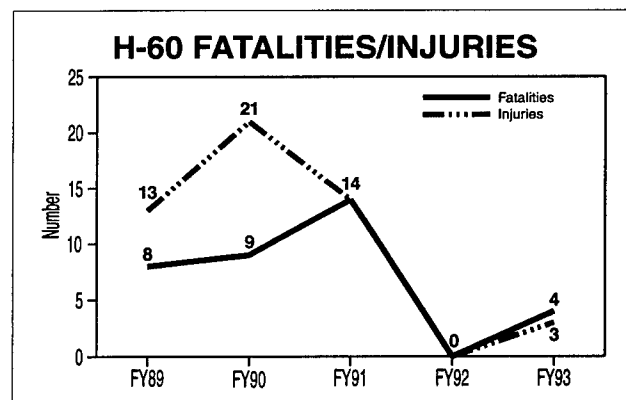


Figure 3-4

Selected accident briefs

An analysis of Class A-C H-60 accidents from FY 89 through FY 93 identified the following as the three types of accidents occurring most frequently:

- Collision with ground or water
- Hard landings
- Wire strikes

Collision with ground or water

Scenario 1. During a night approach, the UH-60A aircraft struck the ground in a nose-high, right-side-low attitude. The 230-gallon right external tank ruptured on impact, engulfing the aircraft with fire.



■ **Result:** Four fatalities, four injuries, a destroyed aircraft, and a cost of \$6,118,900.

■ **Cause:** The external stores support system (ESSS) with extended range fuel system (ERFS) was not designed with adequate safeguards to prevent an out-of-balance condition or a system to alert the crew to the fuel status in each tank.

■ **Crew experience:** The IP had 1,792 hours of flight time, 666 in UH-60s. The PI had 2,754 hours of flight time, 37 in UH-60s.

Prevention techniques and procedures: Apply risk management principles in establishing policies regarding the employment and use of the ESSS with ERFS. The ESSS with EFRS is probably not required for every flight in your unit's UH-60s. In those instances where the extra fuel is not required, remove the system or use another aircraft.

Scenario 2. While in cruise flight at 140 feet AGL on an NVG training mission, the PI was descend-

ing to his planned en route altitude of 100 feet AGL. He did not inform the other crewmembers of his intentions or ask for their assistance to verbally warn him when he passed through 100 feet AGL. The PI did not arrest his descent, and the aircraft impacted a 22-foot-high sand dune with a 200-foot-per-minute rate of descent at 69 KIAS.



■ **Result:** Five injuries, a destroyed aircraft, and a cost of \$4,854,587.

■ **Cause:** The crew failed to recognize and stop the descent for the following reasons:

- A lack of crew coordination and attention. The PC did not announce his intentions to descend, and no one noticed the radar altimeter indications or the low altitude lights.

- Inadequate visual cues to provide information on height above obstacles or terrain.

- Suspected pilot fatigue.

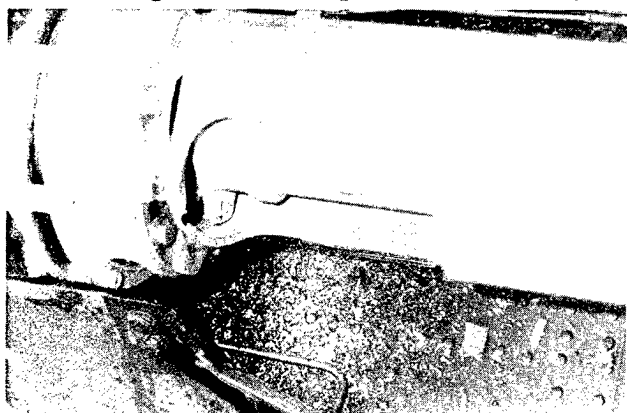
■ **Crew experience:** The IP had 2,081 hours of flight time, 1,914 in UH-60s. The PI had 423 hours of flight time, number of hours in UH-60s is unknown.

Prevention techniques and procedures: Continue training in and employment of good crew coordination procedures. Improve the crew-rest environment as much as possible for aircrews by controlling noise, "hey-you" details, and ensuring crews are provided an uninterrupted rest period. In areas of low contrast and low definition, be aware of the tendency to inadvertently descend to an altitude where visual contact with the ground can be established.

Hard landings

Scenario 1. On takeoff, the crew heard a high-

frequency whine and decided to return to pad. While executing a left turn, they heard a loud "bang." Crew landed aircraft with little forward motion to a dry river bed, damaging the FLIR turret. After shutdown, the crew found that the No. 1 engine high-speed shaft coupling had failed, allowing the shaft to separate from the engine.



■ **Result:** Damage cost of \$362,114.

■ **Cause:** Lab analysis showed that the flex pack had signs of progressive fatigue and one of the mounting bolts had failed.

■ **Crew experience:** The PC had 2,757 hours of flight time, 60 in UH-60s. The PI had 4,370 hours of flight time, 68 in UH-60s.

Prevention techniques and procedures: The pilots executed the correct procedure for the circumstances. Maintenance personnel need to look very carefully when inspecting couplings. (Current checklists do not require inspection of these couplings.)

Scenario 2. While landing at an unimproved LZ as Chalk 2, the aircraft encountered brownout. The aircraft touched down with a high rate of descent and some forward movement—with brakes locked. This caused the aircraft to rock forward, and the FLIR contacted the ground.

■ **Result:** Damage cost of \$341,141.

■ **Cause:** The PC failed to anticipate the results of landing in a brownout condition.

■ **Crew experience:** The PC had 2,885 hours of flight time, 1,637 in UH-60s. The PI had 3,776 hours of flight time, 1,012 in UH-60s.

Prevention techniques and procedures: Crewmembers should anticipate brownout conditions when operating in such an environment and be

prepared to make a go-around. Crewmembers should be sure to continue crew coordination during the approach.

Wire strikes

Scenario 1. Crewmembers were under NVDs as the aircraft departed the NOE route en route to the airfield. The PC became momentarily fixated on a bridge that was not on the crew's map. The PI on the flight controls began a climb and sighted wires at very close range. He pitched the aircraft's nose up in order to "belly" into the wires. The aircraft struck high-power lines and the crew executed an emergency landing to a grass airstrip.



■ **Result:** Damage cost of \$1,007,500.

■ **Cause:** PC failed to properly identify the wire hazards due to overconfidence in his ability to fly the mission without the required detailed pre-mission planning.

■ **Crew experience:** The PC had 737 hours of flight time, 571 in UH-60s. The PI had a total of 255 hours of flight time, 171 in UH-60s.

Prevention techniques and procedures:

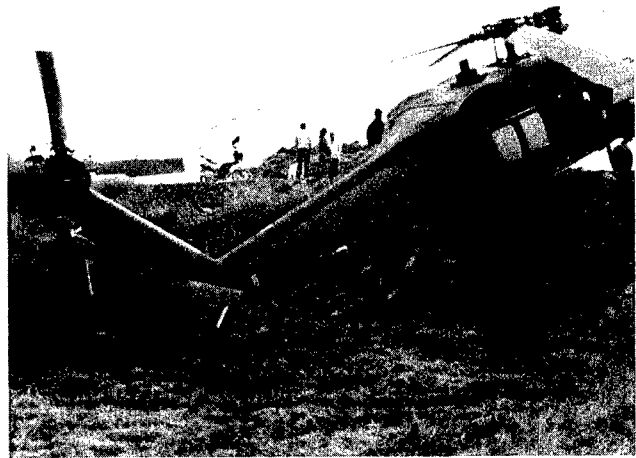
- Post hazard maps and keep them up-to-date.
- Do a hazard reconnaissance to identify wire hazards if you are operating in a new area.
- Mark wires when possible. While wire markers may not be visible under all flight regimes, placing markers on wires is a cost-effective way to avoid the next wire strike.
- Minimize contour flight. Contour flight keeps the aircraft in striking range of many of the "monster wires" or multistrand wires that are most dangerous. If contour flight is necessary, careful and thorough mission planning can mitigate the risk of a wire strike.

- Go slower at lower altitudes.
 - Remain oriented on the map. Most wire strikes occur when the aircrew isn't where they think they are. Ask for help if you become misoriented. Everyone has been lost at some time.
 - Do not assume the other aviator sees the wires. If a sister ship is getting close to wires, don't assume the crew sees the wires. Say something—even if operating under radio silence.
-

Scenario 2. Aircraft was flying at 120 knots and 195 feet AGL when it struck a set of high-tension power lines. The PC elected to perform a roll-on landing into a rice paddy. Just before touchdown, the PC noticed a 10-foot berm. Aircraft landed hard, and the belly of the aircraft impacted the edge of the berm.

■ **Result:** Damage cost of \$295,004.

■ **Cause:** Crew failed to anticipate and correctly identify an in-flight hazard.



■ **Crew experience:** The PC had 379 hours of flight time, 242 in UH-60s. The PI had a total of 803 hours of flight time, 134 in UH-60s.

Prevention techniques and procedures: Same as Scenario 1.

Section IV

AH-1 Safety Performance Review

The AH-1 was involved in 11 Class A accidents, 7 Class B accidents, and 56 Class C accidents during the FY 89 through FY 93 time period. These accidents resulted in six fatalities and seven injuries. The AH-1 cumulative Class A and Class A-C accident rates for the period were 1.85 and 12.42 respectively per 100,000 flight hours based on a total of 595,950 hours, compared to the total rotary wing cumulative Class A and A-C rates of 2.28 and 8.61.

The leading cause of AH-1 accidents continues to be human error. Findings in the eight Class A human-error accidents were distributed as fol-

lows: eight individual failures, three standards failures, three training failures, three leader failures, and one support failure. (Remember that each accident may have more than one cause factor.)

Materiel failure accounted for 3 of the 11 Class A accidents and 1 occurred as a result of environmental factors.

Accident experience

Figures 4-1 through 4-4 depict AH-1 trends over the last 5-year period. Note that trends may appear skewed in FY 91 due to Operations Desert Shield/Storm.

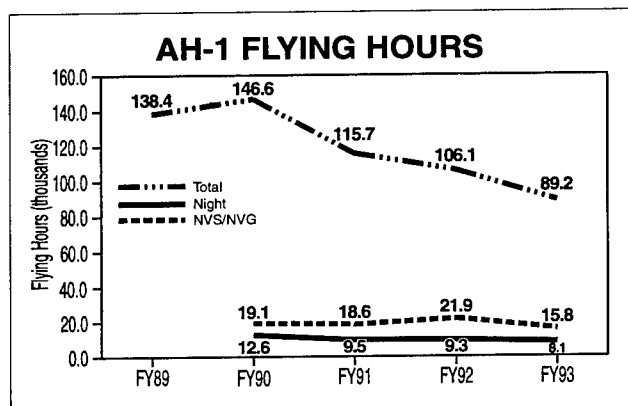


Figure 4-1

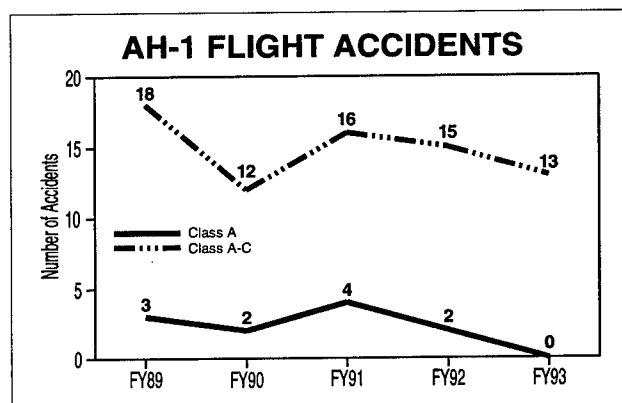


Figure 4-2

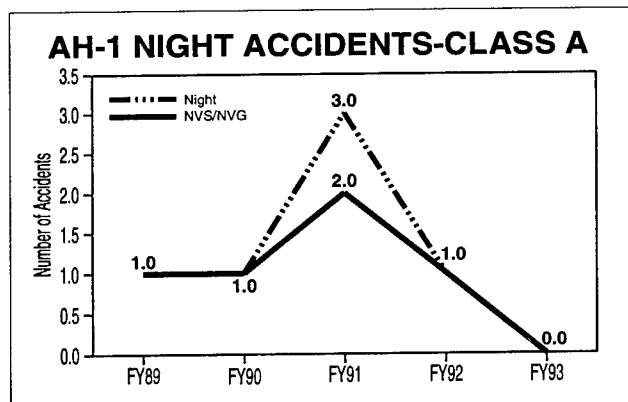


Figure 4-3

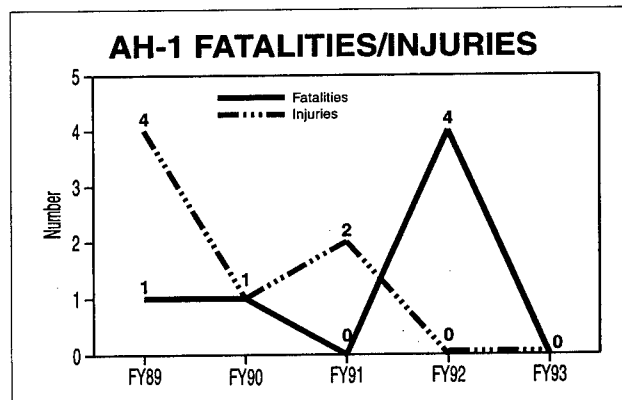


Figure 4-4

Selected accident briefs

An analysis of Class A-C AH-1 accidents from FY 89 through FY 93 identified the following as the three types of accidents occurring most frequently:

- Collision with ground or water
- Tree strikes
- Excessive yaw or spin

Collision with ground or water

Scenario 1. While attempting an NVG departure from a sandy, dusty area, the crew became disoriented in brownout conditions and rolled the aircraft onto its right side. A small postcrash engine fire erupted but was quickly extinguished by ground personnel.



■ **Result:** A destroyed aircraft and a cost of \$1,500,000.

■ **Cause:** The crew failed to execute the recommended blowing dust takeoff procedures in FM 1-202: Environmental Flight or the maximum performance takeoff or instrument takeoff procedures contained in the aircrew training manual.

■ **Crew experience:** The PC had 847 hours of flight time, 654 in AH-1s. The PI had a total of 601 hours of flight time, 434 in AH-1s.

Prevention techniques and procedures: When taking off from very dusty or snowy areas where brownout or whiteout is probable, ensure the aircraft has out-of-ground-effect hover power capabilities. Execute a maximum performance takeoff and clear the first 50 feet as rapidly as power available will allow. Discuss specific crew duties before initiating the takeoff and what you will do if

you lose sight of the ground. Practice instrument takeoffs until proficiency is achieved and then maintain proficiency. Always take off into the wind. A downwind takeoff can be disastrous even with out-of-ground-effect power.

Scenario 2. At 100 feet AGL and 30 to 50 knots during the third sortie on a day aerial gunnery exercise, the T53-L703 engine of the armed AH-1F overheated and failed while en route to the gunnery range from a forward rearming and refueling point. The crew was operating the aircraft in the avoid area of the height-velocity diagram and was unable to execute a successful emergency landing.



■ **Result:** Two fatalities, a destroyed aircraft, and a cost of \$5,913,739.

■ **Cause:** Ingested sand and dirt had built up in the engine gas producer section over time. The sand and dirt buildup restricted the airflow to the engine, causing the engine to overheat and fail.

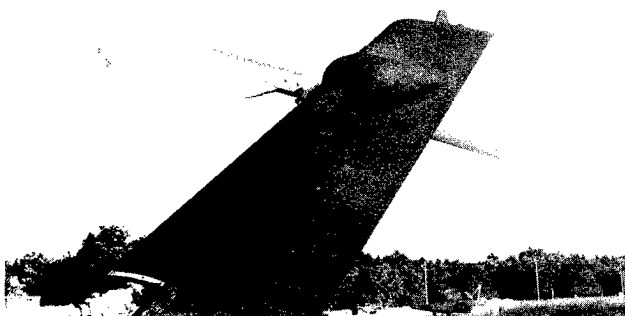
■ **Crew experience:** The PC had 798 hours of flight time, 599 in AH-1s. The PI had 409 hours of flight time, 381 in AH-1s.

Prevention techniques and procedures: When operating in a dusty environment, the engine requires more frequent flushes IAW TM 55-2840-229-23-2: Engine Assembly. If you experience an engine failure at low altitude, do not maneuver excessively. In most cases, continue straight ahead and land rather than attempt a low-level 180-degree turn to land into the wind.

Tree strikes

Scenario 1. The accident aircraft was in an overwatch position on the east edge of a ridgeline. The prevailing winds were calm, and the skid height

of the aircraft was about 5 feet above the trees. The crew had maintained their position for about 1 minute when a slight gust of wind came over the ridgeline. To maintain hover position, the pilot made a slight control input to counteract the wind. As he made the input, the crew heard a buzzing or humming noise and felt a high-frequency vibration in their seats. Realizing something was wrong, the pilot on the controls immediately increased altitude, gained forward airspeed, and began returning to the FARP. Once he gained altitude, the buzzing noise stopped, but the high-frequency vibration continued. The crew landed at the FARP and shut down the aircraft.



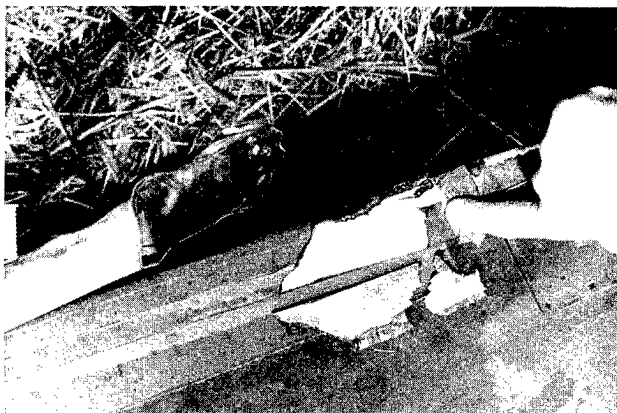
■ **Result:** Damage cost of \$12,601.

■ **Cause:** The crew failed to maintain adequate clearance, and the aircraft's tail rotor struck a tree.

■ **Crew experience:** The PC had 474 hours of flight time, 119 in AH-1s. The PI had 253 hours of flight time, 144 in AH-1s.

Prevention techniques and procedures: Establish scanning sectors and responsibilities for both crewmembers. Follow the terrain flight procedures contained in TC 1-201: Tactical Flight Procedures, adhere to standards, and select a flight mode appropriate to the terrain and vegetation. Identify critical mission points, and rehearse critical points with the crew. No matter how complicated or demanding the mission or training mission becomes, remember to fly the aircraft first. When conducting combat operations, real or otherwise, evaluate terrain and obstacle clearance with this thought in mind, "Must I really be this low or close to the trees?" Usually an extra 10 to 20 feet of clearance will not appreciably degrade the mission.

Scenario 2. Upon completion of a normal shut-down, the PC discovered damage to both main rotor blades. The damage appeared to be confined to the outboard 3 feet of both blades. The crew suspected a tree strike based on small particles of bark and green stains found in the area of the damage.



■ **Result:** Damage cost of \$230,864.

■ **Cause:** Failure to maintain adequate clearance from the trees.

■ **Crew experience:** The PC had 1,150 hours of flight time, 497 in AH-1s. The PI had 219 hours of flight time, 107 in AH-1s.

Prevention techniques and procedures: Same as Scenario 1.

Excessive yaw or spin

Scenario 1. The aircraft was in cruise flight, level at 6,500 feet MSL and at 120 knots on the return leg of an instrument training flight when the No. 1 hanger bearing overheated and failed. As a result, the No. 1 section of the tail rotor drive shaft rubbed against the drive shaft tunnel and was severed. The continuity of the tail rotor drive system was interrupted, causing a loss of effective antitorque control. As the PC fought to regain



aircraft control, the aircraft lost 4,500 feet of altitude. At 2,000 feet MSL, the pilot selected a landing site. At 100 feet AGL, the PC decelerated the aircraft, and at 15 feet AGL, he pulled the collective all the way up. The aircraft landed hard, bounced one time, and came to rest on its belly, leaning on the left wing pods.

- **Result:** Damage cost of \$325,000.

- **Cause:** Hanger bearing failure.

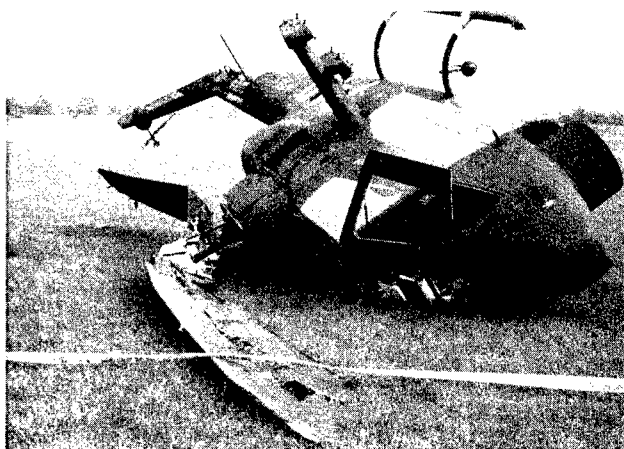
- **Crew experience:** The PC had 4,440 hours of flight time. The PI had 226 hours of flight time.

Prevention techniques and procedures. The procedures for complete loss of tail rotor thrust as explained in the dash 10 were executed properly. As a result of the accident investigation (a preventive technique) the—

- Manufacturer's quality control procedures were improved.
- Bearing was redesigned.
- Inspection criteria were changed.
- Time life of the bearing was reduced.

Scenario 2. At 75 to 90 feet AGL on final for an NVG VMC approach to a stagefield, the aircraft's linear position transducer for yaw channel of SCAS failed. As a result, when the IP applied left pedal input, the failed yaw SCAS did not recognize it as pilot input. Instead of reacting correctly, the SCAS improperly applied a "correction," resulting in an additional right yaw of approximately 5 to 10 degrees. The IP, not realizing the reason for the yaw, immediately corrected with more left pedal. The failed SCAS now sensed a much larger left pedal input and again failed to recognize it as pilot input. The subsequent "correction" resulted in an abrupt right yaw of about

35 to 45 degrees. At this point, the IP interpreted the large yaw as an indication of an engine failure. At 40 to 45 feet AGL, the IP initiated an autorotation by reducing the throttle. Immediately after closing the throttle, the IP began applying collective pitch and simultaneously trying to level the aircraft. The aircraft touched down with low rotor RPM, moved laterally to the right, rolled over, and came to rest on its right side.



- **Result:** Damage cost of \$192,316.

- **Cause:** Failure of linear position transducer yaw channel SCAS and improper interpretation of the emergency by the crewmember.

- **Crew experience:** The IP had 1,094 hours of flight time, 852 in AH-1s. The PI had 140 hours of flight time, 50 in AH-1s.

Prevention techniques and procedures: Develop training scenarios for the 2B34 flight simulator that include multiple emergency procedures with emphasis on those emergencies that could cause confusion. Compound the emergencies when appropriate to better prepare crews for situations such as this one.

Section V

AH-64 Safety Performance Review

The AH-64 was involved in 26 Class A accidents, 12 Class B accidents, and 31 Class C accidents during the FY 89 through FY 93 time period. These accidents resulted in 7 fatalities and 18 injuries. The AH-64 cumulative Class A and A-C accident rates for the period were 6.24 and 16.55 respectively per 100,000 flight hours based on a total of 416,858 hours, compared to the total rotary wing cumulative Class A and A-C rates of 2.28 and 8.61.

The leading cause of AH-64 accidents continues to be human error. Findings in the 11 Class A human error accidents were distributed

as follows: 21 individual failures, 3 standards failures, 14 training failures, 6 leader failures, and 2 support failures. (Remember that each accident may have more than one cause factor.)

Materiel failure accounted for 5 of the 26 Class A accidents and 1 occurred as a result of environmental factors.

Accident experience

Figures 5-1 through 5-4 depict AH-64 trends over the 5-year period. Note that trends may appear skewed in FY 91 due to Operations Desert Shield/Storm.

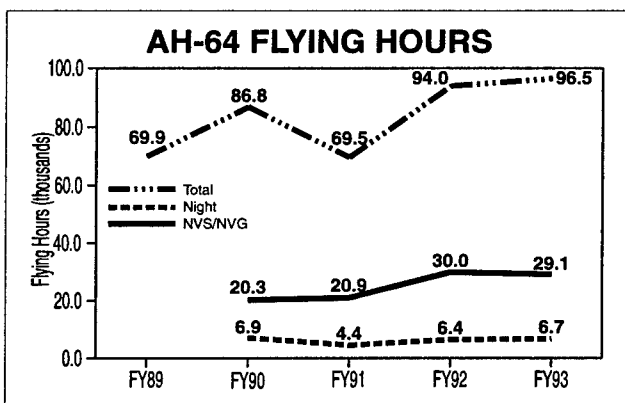


Figure 5-1

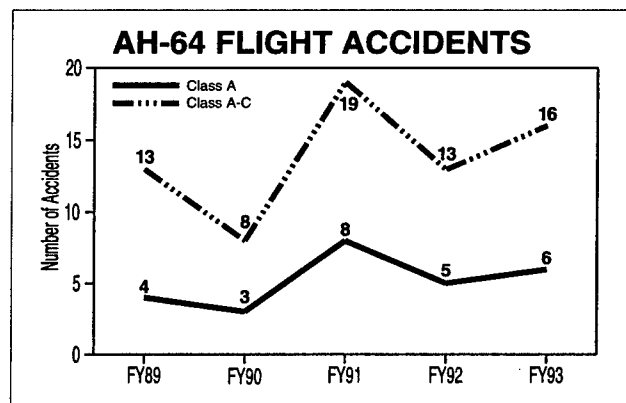


Figure 5-2

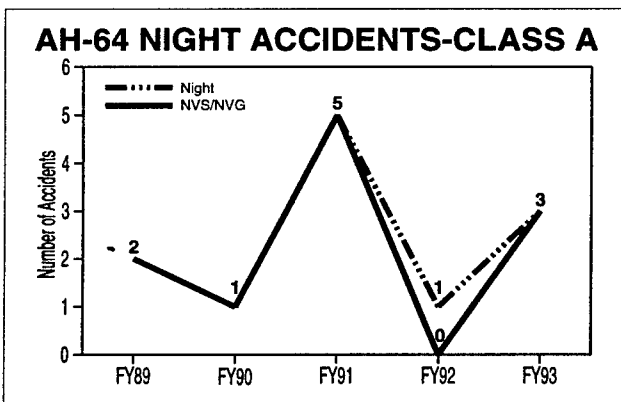


Figure 5-3

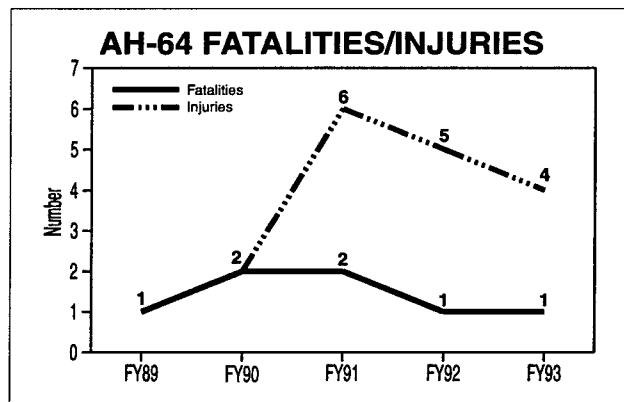


Figure 5-4

Selected accident briefs

An analysis of Class A-C AH-64 accidents from FY 89 through FY 93 identified the following as the three types of accidents occurring most frequently:

- Tree strikes
- Wire strikes
- Flying into the ground

Tree strikes

Scenario 1. The accident aircraft was Chalk 3 in a night, multiship, deep-attack, battalion training mission. The back-seater was using the pilot's night vision system (PNVS), and the front-seater was using the target acquisition designation sight (TADS) during battle-position operations. While in an out-of-ground-effect (OGE) hover, the aircraft entered a left, rearward, descending drift and struck trees with the main and tail rotor systems. The aircraft then began an uncontrolled right spin and impacted the ground on its right side in a nose-low attitude.



■ **Result:** One injury, a destroyed aircraft, and a cost of \$10,765,536.

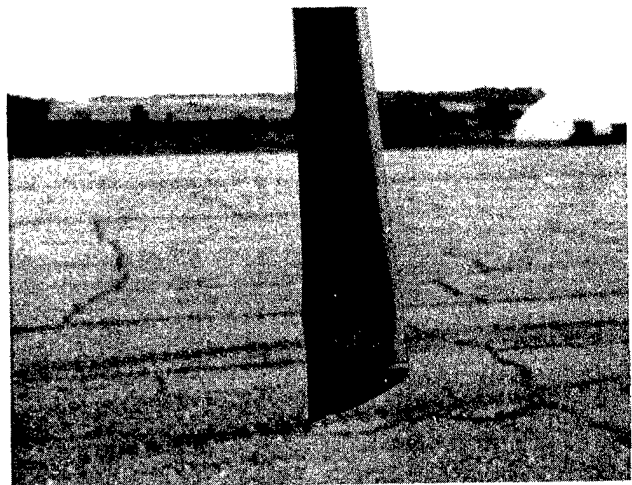
■ **Cause:** The PC failed to properly monitor his aircraft's position in relation to the trees over which he was hovering.

■ **Crew experience:** The PC had 562 hours of flight time, 249 in AH-64s. The PI had 945 hours of flight time, 205 in AH-64s.

Prevention techniques and procedures: Discuss scan techniques for PNVS flight during pre-mission planning. Emphasize teamwork (crew

coordination), including cross check of video displays.

Scenario 2. After completing a situational training exercise, the crew arrived at the battalion forward arming and refueling point (FARP) and established an OGE hover. While waiting for the ground guides, the crew allowed the aircraft to descend into a tree. Neither the PC nor PI detected the descent or the contact with the tree. The PC initiated a go-around when he noticed that the radar altimeter was indicating zero altitude. On the next approach, the crew landed at the FARP and received hot refueling. After completing the refueling operations, the crew departed for their home station. During the postflight inspection, the PC found damage to the stabilator and the four tail rotor blades.



■ **Result:** Damage cost of \$90,415.

■ **Cause:** Inadequate attention by the crew. The crew failed to properly divide their attention between the aircraft symbology/instrumentation and the obstacles around the FARP.

■ **Crew experience:** The PC had 1,056 hours of flight time, 882 in AH-64s. The PI had 744 hours of flight time, 194 in AH-64s.

Prevention techniques and procedures:

Crewmembers should—

- Follow procedures in the aircrew training manual.
- Conform to established standards.
- Be very thorough and careful in maintaining takeoff obstacle clearance, planned terrain flight speeds and altitudes, approach obstacle clear-

ance, hover position, and altitude.

- Be particularly cautious in areas of low contrast and definition.

- Be aware of motion perception deficit (undetected motion).

Practice emergency procedures in the combat mission simulator while occupying a firing or battle position.

- Be cautious when making the transition from en route to a hover mode.

- Refer to appropriate system symbology to assist in stabilizing the aircraft in the firing position. Don't rely on the human proprioceptive system for aircraft motion cues.

Leaders should—

- Ensure that aircrews don't wait until they are overtasked to ask for assistance. Too often aviators become so engrossed in the mission that flying the aircraft becomes of secondary importance. Flying the aircraft may become second nature, but it is never secondary in importance.

- Adhere to the crawl-walk-run approach to training. If an aircrew has never performed a particular mission to standard in the daytime, it is not reasonable to expect them to perform the mission to standard on a very dark night.

- Train air mission commanders in their duties and responsibilities. Seniority in rank or experience does not automatically mean an aviator can function as an air mission commander.

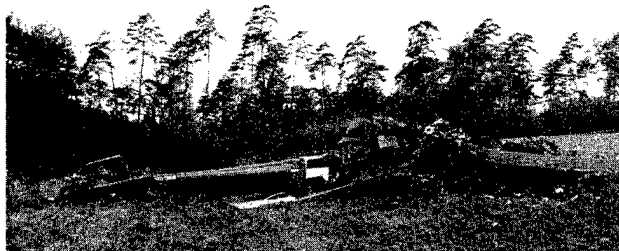
- Start with simpler missions and progress slowly to the more difficult.

Note: Future modifications to the AH-64 may include an altitude hold feature. Hopefully, this will reduce the number of tree strikes caused by uncommanded or unmonitored altitude loss.

Wire strikes

Scenario 1. Following a night low-level, deep-attack training mission using night vision systems, Chalk 4 in a flight of four struck a 3/4-inch multistrand cable on the return route from the battle position. The aircraft crashed in a 36-degree nose-low, 34-degree right-roll attitude onto the top of a berm.

- **Result:** Two fatalities, a destroyed aircraft, and a cost of \$12,500,000.



- **Cause:** Failure to adequately search the field of view for hazards.

- **Crew experience:** The PC had 1,118 hours of flight time, 366 in AH-64s. The PI had 258 hours of flight time, 77 in AH-64s.

Prevention techniques and procedures:

- Post hazard maps and keep them up-to-date.

- Do a hazard reconnaissance to identify wire hazards if you are operating in a new area.

- Mark wires when possible. While wire markers may not be visible under all flight regimes, placing markers on wires is a cost-effective way to avoid the next wire strike.

- Minimize contour flight. Contour flight keeps the aircraft in striking range of many of the "monster wires" or multistrand wires that are most dangerous. If contour flight is necessary, careful and thorough mission planning can mitigate the risk of a wire strike.

- Go slower at lower altitudes.

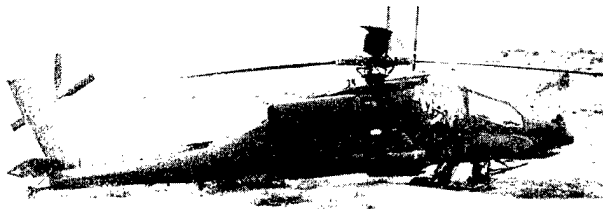
- Remain oriented on the map. Most wire strikes occur when the aircrew isn't where they think they are. Ask for help if you become misoriented. Everyone has been lost at some time.

- Do not assume the other aviator sees the wires. If a sister ship is getting close to wires, don't assume the crew sees the wires. Say something—even if operating under radio silence.

Scenario 2. While flying in a three-aircraft formation conducting a tactical, night, deep-attack training mission, the crew, using the pilot night vision sensor (PNVS) and target acquisition designation sight (TADS), failed to properly scan and maintain their position in relation to the lead aircraft, terrain, and existing obstacles in the area. As a result, the aircraft struck wires and was severely damaged.

- **Result:** Damage cost of \$975,893.

- **Cause:** Inadequate attention as to their



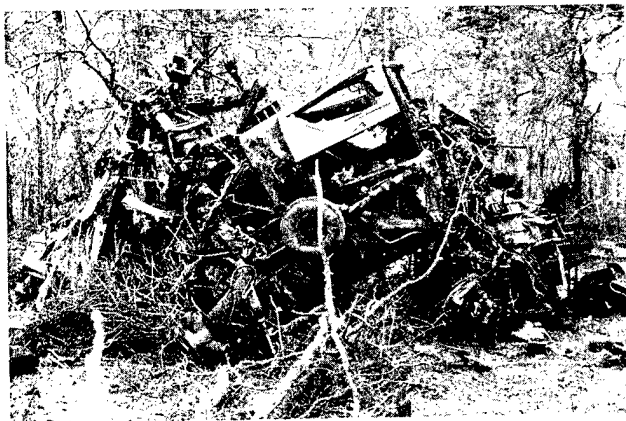
position off the lead aircraft and the terrain over which they were operating. The aircraft descended below the minimum altitude required by the unit tactical standing operating procedures, which would have kept them clear of the wires.

■ **Crew experience:** The PC had 451 hours of flight time, 161 in AH-64s. The PI had 727 hours of flight time, 456 in AH-64s.

Prevention techniques and procedures: Same as Scenario 1.

Flying into the ground

Scenario 1. While attempting a night visual flight rules (VFR) departure and climbout from an unattended airfield, the aircraft entered into instrument meteorological conditions (IMC). The maintenance test pilot (MP) on the controls in the back seat experienced spatial disorientation while in a climbing right turn. The aircraft descended while in the right turn and crashed through large pine trees approximately 0.6 miles east of the point of departure.



■ **Result:** One fatality, a destroyed aircraft, and a cost of \$10,785,000.

■ **Cause:** Failure to maintain control of the aircraft after entering IMC.

■ **Crew experience:** The MP had 5,339 hours of flight time, 1,017 in AH-64s. The PI had 4,262 hours of flight time, 630 in AH-64s.

Prevention techniques and procedures: In this as in other incidents where an aircraft was flown into the ground, the crew had a breakdown in their scanning. Cross-checking flight instruments is important, and avoiding fixation on any one point of reference can allow the crew to detect an unwanted rate of descent before it is too late to recover. Crew coordination is also important, especially when one crewmember becomes spatially disoriented. The back-seat pilot announced that he was experiencing vertigo, but the front-seat pilot did not take control of the aircraft or give assistance in transitioning to instrument flight. The front-seat pilot had the cyclic in the stowed position, which limited his ability to assist in recovering once the aircraft entered IMC.

Scenario 2. While on a day VFR tactical training flight, the IP of Chalk 3 in a flight of three AH-64s in free cruise formation initiated a descending right turn to reposition behind Chalk 2. The aircraft descended into trees, traveling 334 feet before coming to rest on its right side.



■ **Result:** One injury, a destroyed aircraft, and a cost of \$10,688,542.

■ **Cause:** The IP channelized his attention on the other aircraft to ensure separation and subsequently lost situational awareness.

■ **Crew experience:** The IP had 3,345 hours of flight time, 602 in AH-64s. The PI had 2,314 hours of flight time, 254 in AH-64s.

Prevention techniques and procedures: The crew had a breakdown in their scanning. Cross-checking flight instruments and crew coordination are important, especially when one crewmember channelizes attention and loses situational awareness. The crew became so engrossed with formation changes they failed to maintain terrain and obstacle clearance. Crews must maintain situa-

tional awareness and never stop flying the aircraft.

During multiship operations, crews must scan for obstacles in the flight route as well as for obstacles in their own aircraft's flight path. Once identified, hazards should be reported to all aircraft in the flight as the tactical situation allows.

Section VI

H-47 Safety Performance Review

The H-47 was involved in 7 Class A accidents, 4 Class B accidents and 26 Class C accidents during the FY 89 through FY 93 time period. These accidents resulted in 12 fatalities and 6 injuries. The H-47 cumulative Class A and A-C accident rates for the period were 2.51 and 13.25 respectively per 100,000 flight hours based on a total of 279,346 hours, compared to the total rotary wing cumulative Class A and A-C rates of 2.28 and 8.61.

The leading cause of H-47 accidents continues to be human error. Findings in the four Class A human error accidents were distributed as fol-

lows: six individual failures, zero standards failures, one training failure, two leader failures, and zero support failures. (Remember that each accident may have more than one cause factor.)

Materiel failure accounted for three of the seven Class A accidents and none occurred as a result of environmental factors.

Accident experience

Figures 6-1 through 6-4 depict H-47 trends over the 5-year period. Note that trends may appear skewed in FY 91 due to Operations Desert Shield/Storm.

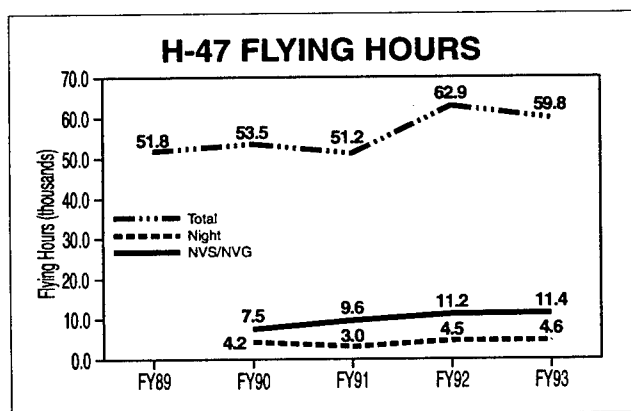


Figure 6-1

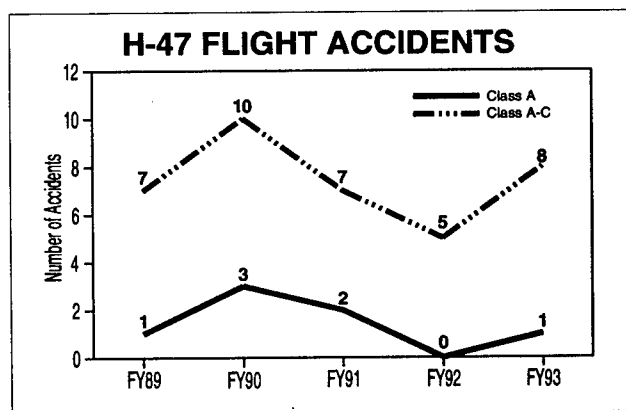


Figure 6-2

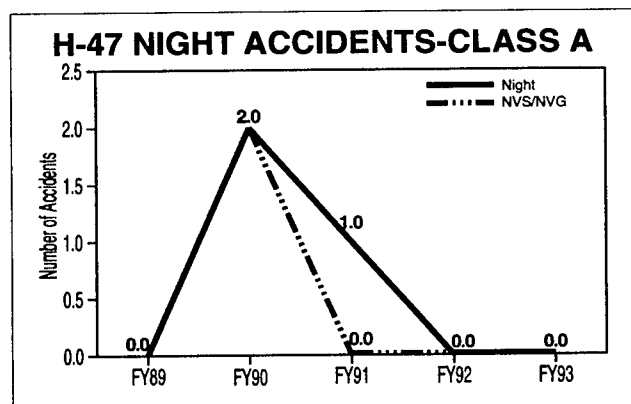


Figure 6-3

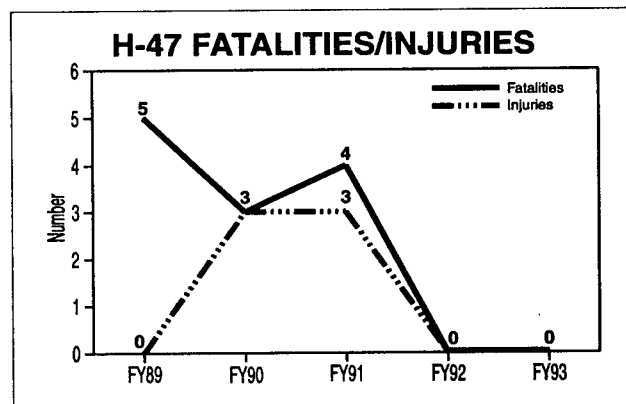


Figure 6-4

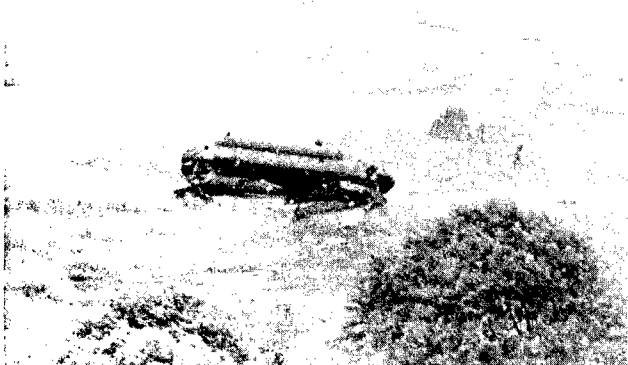
Selected accident briefs

Analysis of Class A-C H-47 accidents from FY 89 through FY 93 identified the following as the three types of accidents occurring most frequently:

- Collision with ground or water
- Cargo accidents
- Object strikes

Collision with ground or water

Scenario 1. The aircraft was operating in near-zero illumination at near-zero airspeed during a night aided, low approach to a beach landing area. The crew had closed all doors and windows in preparation for a dusty landing. At approximately 10 feet AGL, the entire crew experienced a brownout condition. The PC, in the right seat, turned the aircraft left of the intended landing direction in an attempt to maintain visual contact with the ground and the intended landing point. The PI was calling out altitude from the radar altimeter. The flight engineer instructor (FEI), stationed in the right rear of the cabin with the flight engineer (FE), told the pilots to "Hold your down!" The PC started to increase power and diverted his attention from the intended landing point to cross-check his instruments. When he looked outside again, all outside references were obscured by blowing sand and dust, and at this point the aircraft contacted the ground in a 90-degree left yaw. The aircraft rolled over onto its right side, pinning the crew chief (CE), who had been ejected through the *closed* upper cabin door. Aircraft systems were shut down, and the rest of the crew egressed unassisted. It took about 2 hours for the crew and ground troops to free the CE.



■ **Result:** One injury, a destroyed aircraft, and a cost of \$7,504,473.

■ **Cause:** The PC failed to maintain aircraft alignment with the landing direction. He failed to initiate a go-around soon enough because he had flown the same mission during daylight hours, at the same location, without any problems. The lack of crew coordination and communication led each crewmember to think that the other crewmembers had the situation under control. By the time they realized that it was not, it was too late to recover the aircraft. The crew had not discussed the type of approach, landing, or go-around procedures prior to the approach. The PC failed to communicate his approach and landing intentions to the rest of the crew. The entire crew failed to communicate their individual loss of visual contact with the ground.

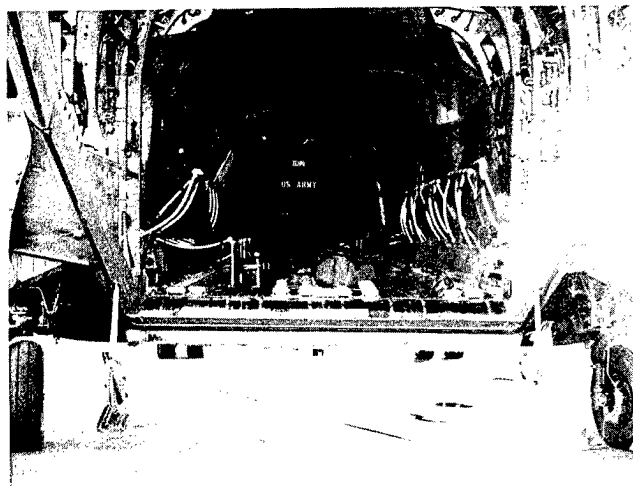
The CE, stationed at the upper cabin door window, was thrown from the aircraft through the closed upper cabin door because he was not using a seatbelt or restraint harness as required by AR 95-1.

■ **Crew experience:** The PC had 2,553 hours of flight time, 769 in CH/MH-47Ds. The PI had 1,370 hours of flight time, 995 in CH/MH-47Ds. The FEI had 5½ years of experience, the FE had 7½ years, and the CE had 3.

Prevention techniques and procedures: Procedures outlined in FM 1-202: Environmental Flight were not followed. The warning in the Desert Operational Procedures section reads "... Hovering and low-altitude, low-speed flight modes should be avoided whenever possible." The FM suggests that "... the best procedure for minimizing blowing dust and sand is a running landing. If the terrain does not permit a running landing, an approach to touchdown should be made, using an approach angle that is greater than the angle used in normal approaches. If a running landing can be made, the touchdown roll should be kept to a minimum to prevent the possibility of overload to the landing gear."

Scenario 2. The aircraft was on a low-altitude and low airspeed night aided approach to the water for a helocast operation. The ramp, with a Zodiac water craft attached, was lowered for the drop. At

approximately 10 feet, the PI attempted to slow the aircraft to the drop speed of 10 knots. An aft drift was detected by the crew, and as the IP initiated corrective action, the ramp entered the water. On impact, a significant amount of water entered the aft cabin section. As the aircraft came out of the water, the ramp broke away taking the Zodiac with it. Appropriate emergency procedures were accomplished, the Zodiac was recovered, and the aircraft returned to home station.



■ **Result:** Damage cost of \$287,627.

■ **Cause:** The IP and the PI lacked adequate training, and the IP failed to maintain the desired speed and height over the water. None of the crewmembers had ever attempted to perform a helocast/soft-duck operation in open water while under NVGs. The mission was part of the battalion's METL, but a special mission task had not been developed to facilitate implementation of training and enforcement of standards of performance to be met before crewmembers could be certified for the various duty positions on this mission.

■ **Crew experience:** The IP had 3,223 hours of flight time, 1,052 in CH-47Ds. The PI had 469 hours of flight time, 309 in CH-47Ds. The SFEI had 1,400 hours of flight time, and the FE had 239 hours of flight time.

Prevention techniques and procedures: TC 1-210: Aircrew Training Program, Commander's Guide to Individual and Crew Training, paragraph 3-2,c. provides guidance for training tasks that "...the commander determines are essential to METL accomplishment but are not listed in the Aircrew Training Manual, Cargo Helicopter, CH-47." The

following references are available for use in developing a helocast/soft-duck special task: FM 31-24: Special Forces Air Operations; 1st SOCOM Regulation 350-6, chapter 6; and SOPs and task lists from other units.

A thorough review of the individual tasks required within the scope of the mission must be completed before performing any mission. Special tasks, as outlined in TC 1-210, that are not performed on a regular basis should be discussed in great detail prior to execution.

When operating in areas of very low contrast and definition, try to find some object upon which to orient. If necessary, bring something that will be highly visible to the crew (e.g., IR chemlite for tactical missions) onboard the aircraft, and throw the object out prior to beginning hover operations, or drop one or more of them at a point where it can be seen throughout the approach and drop/recovery.

Cargo accidents

Scenario 1. A CH-47D crew was conducting training for a combat assault mission that involved insertion of an M198 howitzer battery under night-aided conditions. All required pre-operational checks were satisfactorily completed. The load was an M198 howitzer with A-22 bag, tandem rigged with reach pendants. The hookup was performed without incident, with only minor problems caused by dust. During approach, the crew encountered brownout conditions but managed to get the load on the ground. When the crew attempted to release the load, the forward and aft hook-open lights illuminated on the master caution panel, but the FE informed the pilots that the pendant was still attached to the forward hook. The crew allowed the aircraft to continue drifting forward (230 feet in 3 to 5 seconds), placing tension on the forward hook and dragging the load. The drift continued while several additional release attempts were made. The aircraft attained a dangerously nose-low attitude, requiring both pilots to keep it from pivoting over, nose first. The control inputs by the pilots lifted the M198 off the ground before the FE could manually release it. The M198 was dropped from about 8 feet and damaged on impact. The aircraft was recovered and landed without further incident.

■ **Result:** There were no injuries or aircraft damage. Damage to the M198 howitzer was estimated at a cost of \$20,000.

■ **Cause:** The fact that the load was dragged for 230 feet in 3 to 5 seconds indicates that the forward motion of the aircraft probably was never arrested from the time of approach until the load was released. Brownout conditions, compounded by operating under NVGs, prevented the pilots and crew from maintaining visual references that could have enabled them to detect and prevent the aircraft drift.

The forward and aft hook-open indication in the cockpit results when power is supplied to the hook release mechanism through the release switch. The forward and aft hook-open lights are not an indicator that the hook jaw is actually open.

On the first release attempt, the cargo hook may not have opened at all. Had the weight of the chain legs been resting on the gun tube or the ground, the total weight on the cargo hook jaw may not have been sufficient to counteract the spring tension on the lower jaw. The weight of the reach pendants that were in use is about 18 pounds. During the subsequent release attempts, the pendant's horizontal tension on the forward cargo hook did not allow the sling pendant to fall free of the hook. With the load hanging vertically on the final release attempt, the hook release functioned normally when the manual release was used.

■ **Crew experience:** Unknown (accident occurred during Desert Storm).

Prevention techniques and procedures:

- Crews should come to a stabilized hover over the load before release or initiate a go-around if things don't seem to be right on the first attempt.
- Know how your aircraft systems operate under required mission profiles.
- The weight of the reach pendants is approximately 18 pounds and they are about 5 feet long. In this rigging configuration, the forward clevis and chain legs straddle the gun tube. When descending to slack the slings, the clevis can rest on the ground or gun tube with only the weight of the pendant resting on the hook jaw. The CH-47D Operator's Manual, chapter 4, contains a caution that reads: "The forward and aft hooks may fail to

open if the slings are slack when the release solenoids are energized (a load of approximately 20 pounds is required for opening)." Once forward movement is arrested, releasing the load immediately following load touchdown should ensure sufficient tension to open the hook jaws.

Scenario 2. The following five synopses are typical of external load accidents where the aircraft contacted the load, usually during hookup or release.

■ As the crew was attempting to hook up a vehicle using a shepherd's hook, the aircraft contacted the load. The clevis of the sling was resting in the bed of the vehicle, which gave only 7 to 10 inches of separation between the load and the aircraft.

■ While attempting to hook up two concrete blocks in tandem configuration, the forward hookup man was struck by the aircraft's right front landing gear. He was injured when he fell off the block.

■ During NVG external load operations, the hookup man was struck by the center cargo hook. He fell onto the top of the tandem-rigged HMMWV and was pinned between the load and the aircraft as it drifted downward.

■ As the crew attempted to release the external load, the pilot allowed the aircraft to drift rearward as it was ascending to take the slack out of the sling. The CE informed the PC the aircraft was drifting rearward. The PC stopped the aft drift, but the aircraft continued to ascend and the load overturned.

■ During postflight inspection, the crew found a 6-inch tear in the bottom of the aircraft, near the left aft landing gear. Most likely, the crew allowed the aircraft to descend onto a practice slingload, probably during load release.

Prevention techniques and procedures:

- **Crew coordination.** Analysis of external cargo accidents in which the aircraft contacted the load shows that a significant percentage resulted from a lack of crew coordination. As the clearance between the load and aircraft decreases, the reaction time available decreases proportionately, making effective coordination between all of the crewmembers even more critical. TC 1-210 and TC

1-216 have incorporated crew coordination. TC 1-210 says, "The inclusion of crew coordination in ATM task descriptions reflects the philosophy that no task is an individual undertaking; each one can be performed more effectively and safely by the coordinated efforts of the entire crew."

● **Reach pendants.** As the complexity of executing slingload operations has continued to increase, so has the complexity of training and aircraft systems and capabilities. As new equipment enters the Army inventory it is flight tested and certified for external air transport. New rigging equipment is needed to increase the margin of safety for larger and heavier pieces of equipment. Some of the taller loads such as the M1037 Truck, Shelter Carrier (HMMWV) and the M198 155mm Howitzer, Towed leave a reduced amount of clearance between the load and the aircraft. Procedures in FM 55-450-5: Multiservice Helicopter External Air Transport: Dual Point Load Rigging Procedures now require the use of reach pendants to rig the M198 Howitzer. The reach pendant, however, is not limited to this configuration. Many loads have now been certified for use with these pendants. Some of the benefits provided by pendant use are—

● The additional ground crewmember for static discharge of the aircraft is not required when the pendant is properly used. This provides an added margin of safety in that it reduces the number of people exposed to the hazards of load hookup.

● With the pendant installed, the sling length is increased by approximately 5 feet. This allows, in some cases, for the hookup crew to attach the load to the helicopter without climbing on top of the load, thus decreasing the risk of personal injury.

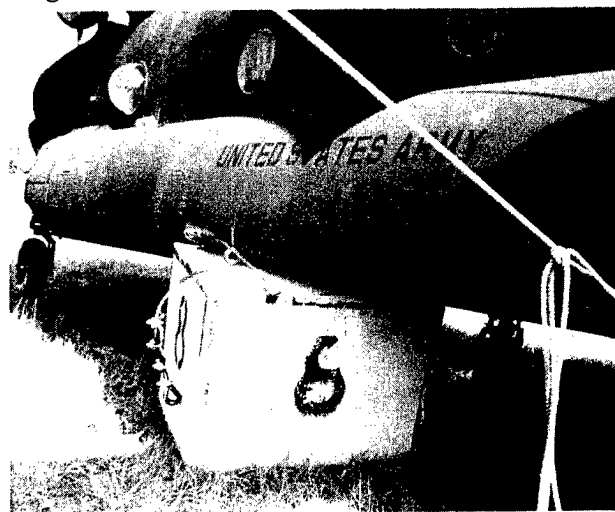
● Use of the reach pendant makes cargo loading pole operations easier for the flight engineer. Without the pendant, the flight engineer has to lift the clevis and sling legs.

Reach pendants are available through the supply system (see *PS Magazine*, September 93 issue). The 25,000-pound capacity pendant, NSN 4020-01-337-3185, will work with both the CH-47 and the UH-60 helicopter cargo hooks. Chapter 8 of FM 55-450-3: Multiservice Helicopter External Air Transport: Basic Operations and Equipment contains information on the reach pendant. Regular

updates on certified external air transport loads are published in *Flightfax*.

Object strikes

Scenario 1. The crew had flown several missions to a stagefield as trail in a flight of two in the early evening while it was still daylight. While making approaches to the west, the PC and PI noted a training load (a concrete block approximately 4 feet square) between the lanes at the west end. They were scheduled to fly night aided missions to the same area. A tail wind experienced during the day made them decide to change landing direction to the east for the after-dark missions. After performing several iterations of fast-rope training, the lead aircraft developed communication problems, and the lead crew suggested that the trail aircraft go ahead and they would catch up for the next traffic pattern. During departure from the stagefield, under NVGs, the trail aircraft crew allowed the aircraft's right front landing gear to contact the training load, causing the aircraft to pitch nose low. The PI quickly attempted to bring the nose up, causing vibrations in the airframe. Perceiving the vibrations to be severe, the PI elected to set the aircraft down. As the helicopter descended, the load penetrated the fuselage.



■ **Result:** Damage cost of \$157,072.

■ **Cause:** During takeoff, the PI failed to detect a large concrete block to his right front because his attention was focused on an aircraft in front of him. He was trying to combine NVG takeoff procedures with diagonal movement, which is contrary to established procedure in TC

1-216. The pilots did not communicate the existence or position of the block to the nonrated crewmembers.

■ **Crew experience:** The PC had 2,097 hours of flight time, 1,084 in CH-47Ds. The PI had 1,904 hours of flight time, 362 in CH-47Ds. The FE had 4 years of experience and 600 hours of flight time in CH-47Ds, the CE had 2½ months of experience in CH-47Ds, and the CE/Safety had 4 years of experience in CH-47Ds.

Prevention techniques and procedures: Avoid situations where deviation from ATM procedures is necessary. The PC should have first repositioned the aircraft for takeoff. This would have allowed him to focus his attention on the flightpath.

The 4-foot-tall training load was easily identifiable during daylight hours, however, at night there was little contrast between its yellow-painted concrete surface and the surrounding flat, brown-grass-covered terrain. Units should consider the following:

- In a training area used for night and night-aided training, known obstacles—such as training aids—should be marked with reflective tape or paint and placed in predetermined positions when not in use.
- Multiple aircraft using the same training area during night and night-aided training should coordinate placement of training loads before leaving a training load in other than the established location.
- A daylight recon should be performed just before the flight in areas where obstacle position continually changes. Obstacle locations and clearing responsibility should be assigned to individual crewmembers.
- Use of the IR searchlight should be encouraged for at least the first iteration to verify obstacle position and clearance.

Scenario 2. The aircraft was taxied along the left side of the taxiway in preparation for a right turn into parking position. As the aircraft turned right

to line up on a ground guide, the aft rotor blades struck a light pole.

■ **Result:** Damage cost of \$70,337.



■ **Cause:** The PC, who was following the instructions of a single ground guide, taxied the aircraft too close to a light pole. The pole was within 75 feet of the aircraft, and the PC did not dismount a blade watcher in addition to the ground guide. This is contrary to the requirements of the CH-47D Operator's Manual, chapter 8.

The PC did not wait for clearance from the FE of his intention to turn the aircraft. The FE was not in position to observe the aft portion of the aft rotor system during taxi.

The ground guide positioned the aircraft where there was insufficient clearance and failed to monitor obstruction clearance during taxi.

■ **Crew experience:** The PC had 2,117 hours of flight time, 531 in CH-47Ds. The PI had 345 hours of flight time, 211 in CH-47Ds. Total experience and flight time of the three enlisted crew members on board is unknown. Two were FE qualified and one was CE qualified.

Prevention techniques and procedures: Follow procedures outlined in the ATM and operators manual when in close proximity to obstacles. All crewmembers should continue to clear the aircraft regardless of available ground guide support.

Section VII

OH-58A/C Safety Performance Review

The OH-58A/C was involved in 35 Class A accidents, 1 Class B accident, and 56 Class C accidents during the FY 89 through FY 93 time period. These accidents resulted in 17 fatalities and 22 injuries. The OH-58A/C cumulative Class A and A-C accident rates for the period were 2.79 and 7.33 respectively per 100,000 flight hours based on a total of 1,255,012 hours, compared to the total rotary wing cumulative Class A and A-C rates of 2.28 and 8.61.

The leading cause of OH-58A/C accidents continues to be human error. Findings in the 28 Class A human error accidents were distributed

as follows: 51 individual failures, 4 standards failures, 14 training failures, 5 leader failures, and 2 support failures. (Remember that each accident may have more than one cause factor.)

Materiel failure accounted for 3 of the 35 Class A accidents and 1 occurred as a result of environmental factors.

Accident experience

Figures 7-1 through 7-4 depict OH-58A/C trends over the 5-year period. Note that trends may appear skewed in FY 91 due to Operations Desert Shield/Storm.

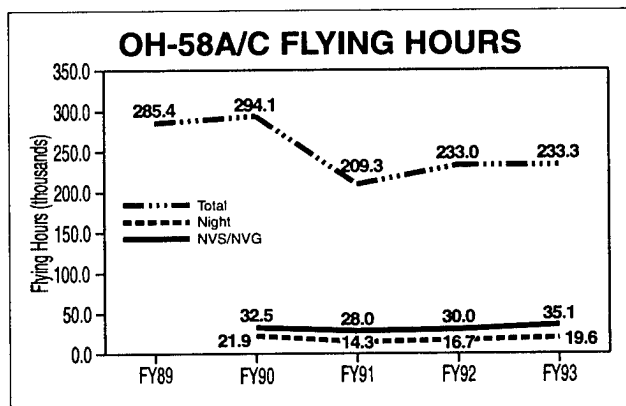


Figure 7-1

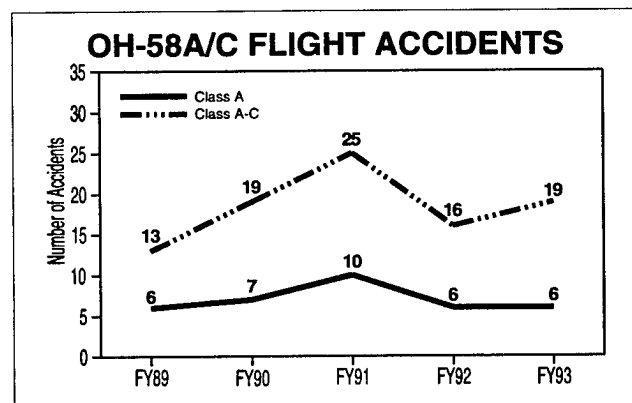


Figure 7-2

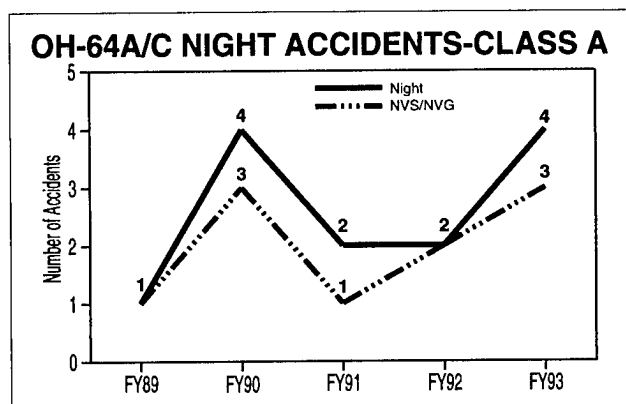


Figure 7-3

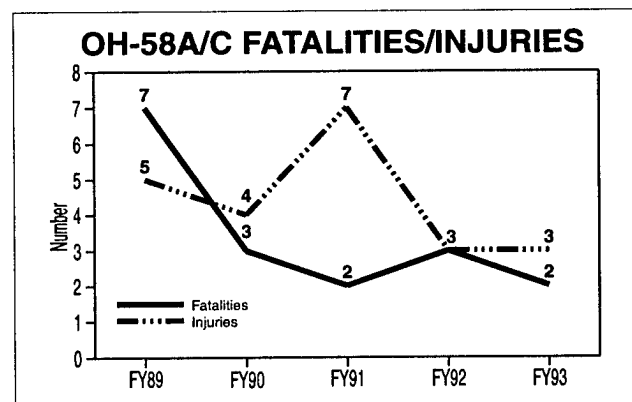


Figure 7-4

Selected accident briefs

Analysis of Class A-C OH-58A/C accidents from FY 89 through FY 93 identified the following as the three types of accidents occurring most frequently:

- Collision with ground or water
- Wire strikes
- Dynamic rollover

Collision with ground or water

Scenario 1. At 40 to 50 feet AGL and 10 to 15 knots while performing an aerial reconnaissance, the PI initiated a slow, right-pedal turn and failed to anticipate the loss of tail rotor effectiveness (LTE). As a result, the aircraft entered an uncommanded right yaw that rapidly developed into a spin. The spin continued to the point that the PI lost positive control of the aircraft, and it crashed into the side of a ridgeline.



■ **Result:** A destroyed aircraft and a cost of \$92,770.

■ **Cause:** The PI failed to anticipate LTE because of inadequate experience. Although he was academically trained and knowledgeable about the LTE phenomenon, he failed to make practical application of what he knew when he experienced loss of directional control. He had not developed a full appreciation for the probability of encountering LTE. Furthermore, he had not received hands-on training that would prepare him to avoid or successfully recover from the emergency because there is no authorized training maneuver to demonstrate the characteristics of entry into or recovery from LTE.

■ **Crew experience:** The PC had 310 hours of

flight time, 236 in OH-58s. The PI had 488 hours of flight time, 412 in OH-58s.

Prevention techniques and procedures: Basic guidance for LTE is contained in TM 55-1520-228-10: Operator's Manual Army Model OH-58 A/C Helicopter. Ensure you are familiar with it. LTE is considered an emergency procedure and, like all emergency procedures, should be treated seriously. Do not allow a right yaw to develop beyond a slight deviation. Immediately correct with left pedal. When operating at airspeeds below effective translational lift, plan ahead and give yourself room to maneuver if necessary. Most important, develop a habit of avoiding conditions conducive to LTE.

Scenario 2. During recovery from an NVG aerial observer (AO) training mission, the IP failed to maintain aircraft control. From an altitude of between 300 and 600 feet AGL, the aircraft descended and impacted the ground in an unusual attitude at an airspeed in excess of 100 knots.



■ **Result:** Two fatalities, a destroyed aircraft, and a cost of \$1,348,890.

■ **Cause:** The IP's loss of aircraft control may have resulted from an in-flight emergency in deteriorating weather conditions. The IP may have experienced an engine overspeed condition while climbing to altitude after clearing an NOE route without the assistance of another rated pilot. An engine overspeed in deteriorating weather conditions using NVGs is a condition conducive to spatial disorientation. The altitude at which the aircraft was operating at the onset of the emergency would have degraded the IP's chances of

successful recovery.

■ **Crew experience:** The IP had 2,076 hours of flight time, 1,864 in OH-58s. The AO had 50 hours of flight time, all of them in OH-58s.

Prevention techniques and procedures:

- Ensure that nonrated crewmembers are proficient in a maneuver during daylight conditions before asking them to do the mission at night.
 - When conducting no-notice aviator checkrides, try to end the evaluation with an inadvertent IMC recovery. Performing the local IMC recovery procedure not only makes it easier for aviators to execute the procedure when it becomes necessary, the local air traffic control agency also receives training.
-

Wire strikes

Scenario 1. The crew was conducting an approved zone reconnaissance training mission in accordance with TC 1-215: Aircrew Training Manual, Observation Helicopter, OH-58A/C, Task 2066. The aircraft struck a 1/4-inch wire that wrapped around the skid crossmembers. The aircraft traveled about 200 meters before crashing nose first, followed by a right rolling motion into the ground. The fuselage bounced forward about 20 feet and came to rest on its right side.



■ **Result:** One fatality, one injury, a destroyed aircraft, and a cost of \$1,304,470.

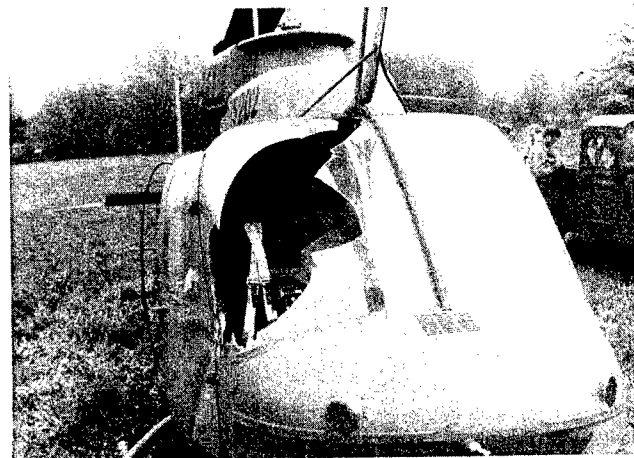
■ **Cause:** Failure to follow procedures. The PC did not use a tactical 1:50,000 scale map during mission planning, and he was unable to adequately brief his AO. He also did not have a map depicting wire hazards along the flight route with him in the aircraft.

■ **Crew experience:** The PC had 459 hours of flight time, 378 in OH-58s. The AO had 202 hours of flight time.

Prevention techniques and procedures:

- Post hazard maps and keep them up-to-date.
 - Do a hazard reconnaissance to identify wire hazards if you are operating in a new area.
 - Mark wires when possible. While wire markers may not be visible under all flight regimes, placing markers on wires is a cost-effective way to avoid the next wire strike.
 - Minimize contour flight. Contour flight keeps the aircraft in striking range of many of the "monster wires" or multistrand wires that are most dangerous. If contour flight is necessary, careful and thorough mission planning can mitigate the risk of a wire strike.
 - Go slower at lower altitudes.
 - Remain oriented on the map. Most wire strikes occur when the aircrew isn't where they think they are. Ask for help if you become misoriented. Everyone has been lost at some time.
 - Do not assume the other aviator sees the wires. If a sister ship is getting close to wires, don't assume the crew sees the wires. Say something—even if operating under radio silence.
-

Scenario 2: During an NOE NVG training mission, the aircraft entered a set of six horizontally spaced wires. All wires were severed by the aircraft. The pilot made an immediate precautionary landing with power to a sloped field.



■ **Result:** Damage cost of \$113,438.

■ **Cause:** Failure to decrease airspeed

commensurate with restricted visibility in order to provide obstacle recognition and avoidance time. The aircraft was 800 meters off course and the hazards were not reconned or marked.

■ **Crew experience:** The PC had 744 hours of flight time, 698 in OH-58s. The AO had 434 hours of flight time.

Prevention techniques and procedures: Same as Scenario 1.

Dynamic rollover

Scenario 1. While attempting a takeoff to a hover from level terrain at a field site, the IP did not properly coordinate his flight controls to establish a vertical ascent as required by TC 1-215, Task 1017. He failed to adjust cyclic input to establish a vertical ascent with the aircraft, which he knew was right-side heavy, and then did not reduce the collective pitch control in time to correct for the developing dynamic rollover condition. As a result, the right roll progressed beyond the aircraft's critical rollover angle and the main rotor blades made ground contact with a 2-foot embankment on the right side of the aircraft.



■ **Result:** A destroyed aircraft and cost of \$92,290.

■ **Cause:** Failure of the IP to adjust cyclic input to establish vertical ascent. The IP's actions resulted from his failure to observe the aircraft roll rate as the left skid left the ground. Contributing to the IP's distraction was his attempt to get the AO to monitor the engine turbine outlet temperature during the takeoff.

■ **Crew experience:** The IP had 4,489 hours of flight time, 1,231 in OH-58s. The PI had 1,076 hours of flight time, 115 in OH-58s. The AO had 153 hours of flight time, 149 in OH-58s.

Prevention techniques and procedures: Dynamic rollover is an old problem that must be reemphasized periodically. FM 1-203: Fundamentals of Flight and numerous training POIs discuss dynamic rollover in detail. Review them carefully.

Scenario 2: During a night-aided landing in tall grass, the PC became spatially disoriented and misinterpreted the aircraft's actions. The blowing tall grass and the lack of visual cues, in conjunction with a perceived slope, resulted in the PC becoming spatially disoriented. As a result, he permitted the aircraft to roll right to the point the main rotor blades made ground contact.



■ **Result:** A destroyed aircraft and a cost of \$93,335.

■ **Cause:** Spatial disorientation and overconfidence. Due to the repetitive nature of the missions in which he had been involved for the past 10 days, his more than 100 hours of experience with NVGs, and his awareness of the successful landing of an aircraft in the same area a short time earlier, the PC was lulled into a complacent state of well-being. This business-as-usual attitude contributed to his misinterpretation of what the aircraft was doing as well as a breakdown in crew coordination.

■ **Crew experience:** The PC had 754 hours of flight time, 665 in OH-58s. The PI had 1,121 hours of flight time, 302 in OH-58s.

Prevention techniques and procedures: During landings, ensure all crewmembers are carefully

observing their scan sectors and are situationally aware. All aircrewmembers are susceptible to the relative-motion illusion when hovering over tall grass or blowing snow. If the PI does not continue his scan as descent continues, he may allow the aircraft to drift in the direction the grass or snow is

blowing. If the lateral drift is not trimmed out with the cyclic as a skid makes contact with the ground, dynamic rollover can occur. Do not fixate; continue to scan. Review FM 1-203 and training POIs that discuss dynamic rollover.

Section VIII

OH-58D Safety Performance Review

The OH-58D was involved in 13 Class A accidents, 5 Class B accidents, and 18 Class C accidents during the FY 89 through FY 93 time period. These accidents resulted in 4 fatalities and 11 injuries. The OH-58D cumulative Class A and A-C accident rates for the period were 11.49 and 31.83 respectively per 100,000 flight hours based on a total of 113,100 hours, compared to the total rotary wing cumulative Class A and A-C rates of 2.28 and 8.61.

The leading cause of OH-58D accidents continues to be human error. Findings in the 11 Class A human error accidents were distributed as fol-

lows: 15 individual failures, 5 standards failures, 6 training failures, 0 leader failures, and 9 support failures. (Remember that each accident may have more than one cause factor.)

Materiel failure accounted for 3 of the 13 Class A accidents and 2 occurred as a result of environmental factors.

Accident experience

Figures 8-1 through 8-4 depict OH-58D trends over the 5-year period. Note that trends may appear skewed in FY 91 due to Operations Desert Shield/Storm.

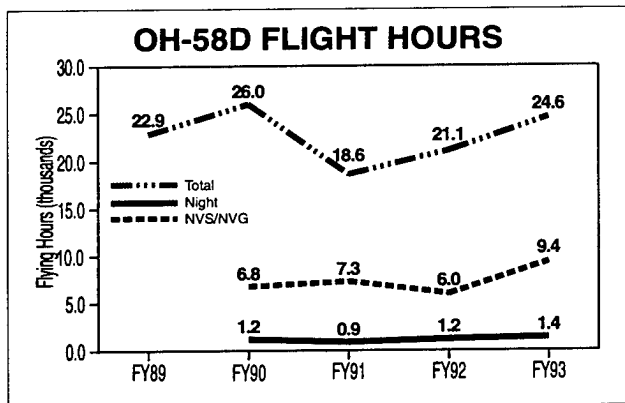


Figure 8-1

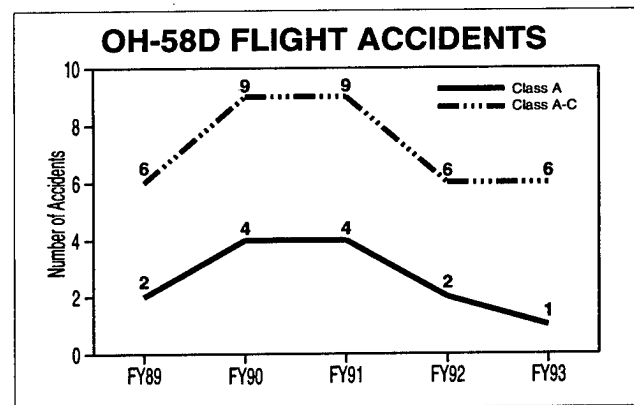


Figure 8-2

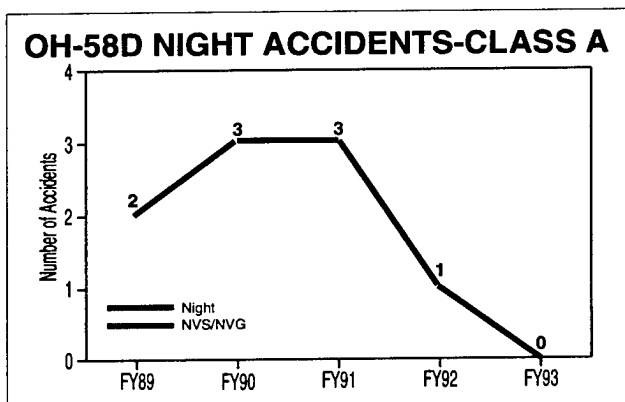


Figure 8-3

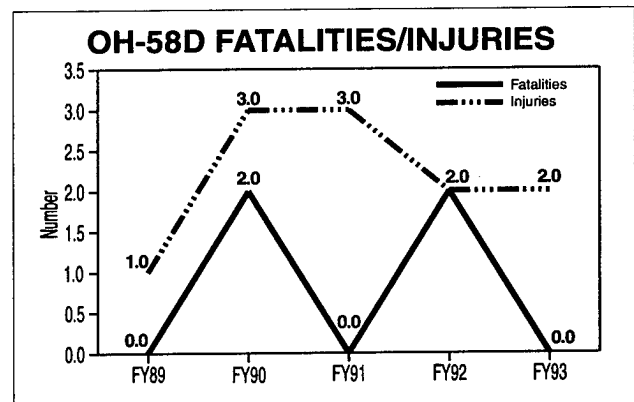


Figure 8-4

Selected accident briefs

Analysis of Class A-C OH-58D accidents from FY 89 through FY 93 identified the following as the three types of accidents occurring most frequently:

- Collision with ground or water
- Fuel starvation
- Engine failure

Collision with ground or water

Scenario 1. While flying at between 600 and 800 feet above ground level and at 110 to 115 knots, the PC willfully violated AR 95-1: Flight Regulation, paragraph 2-10 by conducting an unauthorized aerobatics maneuver—a right roll in excess of 90 degrees. As a result, the aircraft rolled inverted and entered a steep dive. The PC was unable to regain control of the aircraft before it impacted trees. The PC had been verbally counseled while at the National Training Center for flying too low and exceeding limitations during turns. The PC had also been observed performing unauthorized maneuvers (steep cyclic climbs with negative "G" dives) 2 days before the accident.



■ **Result:** Two injuries, a destroyed aircraft, and a cost of \$3,891,844.

■ **Cause:** The PC was attempting to perform an unauthorized maneuver.

■ **Crew experience:** The PC had 359 hours of flight time, 267 in OH-58Ds. The TO had 164 hours of flight time.

Prevention techniques and procedures: Flying strictly by the book will prevent this kind of acci-

dent. You may have never attempted an unauthorized aerobatic maneuver and have no intention of ever doing so, but is there someone in your unit who makes a habit of exceeding safe operating parameters? If you know of such a person, no matter if the individual is a friend, you are responsible for reporting it to the chain of command. If you don't, you have just helped set a new standard—the lowest standard—for operations in your unit, and you might cost someone their life.

Scenario 2. During a night NVG takeoff at 50 feet AGL and 40 to 60 KIAS, the IP, in the left seat, attempted to take control of the aircraft. The IP was unable to control the aircraft and it crashed. The aircraft impacted the ground, right side low, in a near-vertical descent. The wreckage was largely consumed by a postcrash fire.



■ **Result:** Two injuries, a destroyed aircraft, and a cost of \$3,836,056.

■ **Cause:** The IP failed to properly preflight the aircraft in accordance with the operators manual (he failed to ensure the cyclic was engaged for flight). The PI failed to properly transfer the aircraft flight controls to the IP. He did not feel the IP move the flight controls and did not visually confirm positive transfer before releasing the controls. After releasing the controls, the PI observed the IP struggling with both hands on the cyclic control, but he remained clear. There was no communication between the pilots. The IP thought he had a hydraulic problem when in fact the cyclic was in the lockout position. The PI had been briefed that whoever was at the controls would execute the appropriate emergency procedure, and he did not want to interfere with the IP's

execution of the emergency procedure.

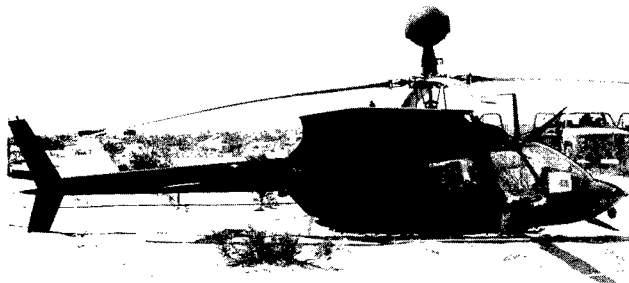
■ **Crew experience:** The IP had 7,702 hours of flight time, 180 in OH-58Ds. The PI had 220 hours of flight time, 51 in OH-58Ds.

Prevention techniques and procedures: The dash 10 has been changed to include actions to correct the cyclic lockout problem. If there is any doubt about what is happening with the aircraft, the pilots must talk with each other. Don't sit there and watch the aircraft crash without saying a word or offering assistance!

The aircrew training manual, under standard cockpit terminology, provides a good technique for transfer of flight controls. However, if you're operating under night vision goggles or systems, you should also feel a control input by the other aviator before relinquishing control of the aircraft.

Fuel starvation

Scenario 1. During a VMC flight to a secure area, the fuel boost pump failed. The PC turned the boost pump off in accordance with the operators manual. At 400 feet AGL about 3 to 5 minutes later, the PC was attempting to accelerate from 70 to 100 knots when the low rotor RPM audio sounded and the airframe began to vibrate. The PC confirmed an engine failure and initiated an autorotation. During the descent the rotor warning ceased, indicating there was adequate rotor RPM. The aircraft touched down slightly nose high with the tail skid on the ground. Both skids made ground contact at the same time, and the aircraft began sliding forward. The skids dug into the sand, causing the wire cutter to act as a brake. As the aircraft abruptly slowed, the rotor system flexed down and severed the tail boom. The aircraft continued to slide a short distance before coming to rest on its left side.



■ **Result:** Damage cost of \$3,756,000.

■ **Cause:** The fuel boost impeller assembly and plain seal were worn. The flameout resulted when the PI increased demand on the fuel system to increase forward airspeed. The increased fuel demand coupled with an inoperable fuel boost pump and an air leak between the fuel boost pump and the engine was too much for the fuel system to handle.

All physical evidence indicates a good autorotation was initiated and continued to touchdown, except that the aircraft touched down with excessive ground run.

■ **Crew experience:** The PC had 1,854 hours of flight time, 411 in OH-58Ds. This was a single pilot mission.

Prevention techniques and procedures: For a fuel boost pump failure, the proper procedure is to land as soon as practical. The PC in this case followed the proper emergency procedure. He was en route to the nearest secure area when the engine failed. Because of the soft sand in the landing area, he should have attempted to execute a minimum ground run autorotation. It should be noted that factors such as height perception and availability of relative motion cues greatly influence how well touchdown speeds can be ascertained.

Scenario 2. At about 10 feet above the trees and 10 knots while flying NOE over a heavily wooded area, the engine surged and the aircraft abruptly yawed right. The engine then failed, accompanied by engine-out and low rotor RPM indications. The pilot on the controls placed the aircraft in a slightly nose-high attitude as the aircraft



descended into the trees.

■ **Result:** Two injuries, a destroyed aircraft, and a cost of \$3,984,147.

■ **Cause:** The fuel boost valve stem had been bent slightly when installed. The restricted fuel flow caused by the bend in the valve stem allowed the engine to function properly during low fuel demands but was not adequate for higher fuel demands. The bent valve stem prevented the engine fuel pump from providing an adequate volume of fuel required for the high power setting required for OGE maneuvers.

■ **Crew experience:** The PC had 638 hours of flight time, 560 in OH-58Ds. The PI had 845 hours of flight time, 99 in OH-58Ds.

Prevention techniques and procedures: The cause of the engine failure was essentially the same as for Scenario 1, inadequate fuel flow at a time of high fuel demand. The difference is that this PC didn't have time to execute an autorotation.

There simply is not much a pilot can do when a fuel boost pump fails except to follow the published emergency procedure. The pilots in both of these scenarios did that. One was able to reach an area where autorotation was possible, the other was not so lucky.

After an evaluation of fuel boost pump design on the OH-58D, it was determined the pump does not exhibit an unusual failure rate. That is little consolation, however, if the aircraft on which it happens is the one you are flying. The OH-58D community should be alert to the problem of fuel boost pump failure. Particular attention should be given to checking pumps on these aircraft and to ensuring that air leaks are not present in the fuel system. Maintenance personnel should also review installation procedures to ensure that problems such as the bent valve stem do not occur.

Engine failure

Scenario 1. While in cruise flight on a routine training mission, the IP initiated a simulated engine failure (SEF) as a demonstrated maneuver to the artillery fire support officer (AFSO). At 400 feet AGL, the IP attempted to make a power recovery. The aircraft lost power and began losing RPM. A near-vertical descent resulted, and the aircraft hit the ground hard.



■ **Result:** Damage cost of \$320,959.

■ **Cause:** The engine failed as a result of a loose compressor discharge pneumatic (PC) air line. The IP failed to recognize an engine-out condition before initiating a power recovery. He further erred by applying collective pitch to the main rotor in anticipation of rotor overspeed.

■ **Crew experience:** The IP had 3,124 hours of flight time, 793 in OH-58Ds. The AFSO had 157 hours of flight time.

Prevention techniques and procedures: TC 1-209: ATM Observation Helicopter, OH-58D Aviator/Aeroscout Observer explains the procedure for doing simulated engine failure. While an actual engine failure does not often happen during a power recovery from an SEF, it seems almost axiomatic that if an engine will fail, it will fail during this recovery process. Ensure the maneuver is initiated only when a good landing area is available and can be reached. Anticipate what you would do if an engine failure did happen and you won't be surprised. Anticipate the use of collective to correct for high rotor RPM; do not lead with collective.

Scenario 2. The aircraft was at a 30-foot stationary hover when it experienced a compressor stall. The PI reduced collective, and the aircraft began a left yaw. The yaw increased to about 360 degrees, and the IP initiated autorotation from about 20 feet. The aircraft came to rest in an irrigation ditch with an approximate 30-degree roll.

■ **Result:** Damage cost of \$856,000.

■ **Cause:** While conducting training with the OH-58D airborne target handover system, the

crew hovered the aircraft with a tailwind in excess of 20 knots. This deviated from the OH-58D interim statement of airworthiness qualifications (ISAQ). The engine lost power due to a suspected compressor stall as a result of the excessive tailwind. Written procedures warning aviators of the hazards when hovering aircraft in excessive tailwinds are inadequate.

■ **Crew experience:** The IP had 1,016 hours of flight time, 564 in OH-58Ds. The pilot had 296 hours of flight time, 130 in OH-58Ds.

Prevention techniques and procedures:

- **Revise the OH-58D interim statement of airworthiness qualification (ISAQ), dated 20 April 1993, to include a clear and complete explanation that will permit aircrews to interpret airspeed limitations and wind conditions relating to sideward or rearward flight and/or comparable wind speeds. Include compressor stalls under these conditions.**
- **Direct a review of the OH-58D operators manual to ensure it includes an explanation that is correct, specific, and understandable of flight limitations**



and restrictions as they pertain to various environmental conditions. Include in the operators manual appropriate notes, cautions, or warnings about possible engine power surges or compressor stalls that may occur under similar conditions.

- **Review the status of the OH-58D cowling modification work order (MWO) to see if expedited fielding of the MWO is feasible.**
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Section IX

Fixed Wing Safety Performance Review

Fixed wing aircraft were involved in 10 Class A accidents, 6 Class B accidents, and 43 Class C accidents during the FY 89 through FY 93 time period. These accidents resulted in 17 fatalities and 7 injuries. The fixed wing cumulative Class A and A-C accident rates for the period were 1.17 and 6.91 respectively per 100,000 flight hours, based on a total of 853,766 hours.

The leading cause of fixed wing accidents continues to be human error. Findings in the 10 Class A human error accidents were distributed as follows: 15 individual failures, 0 standards failures, 7 training failures, 5 leader failures, and 1

support failure. (Remember that each accident may have more than one cause factor.)

Materiel failure accounted for 1 of the 10 Class A accidents and 1 occurred as a result of environmental factors.

Accident experience

Figures 9-1 through 9-3 depict fixed wing trends over the 5-year period. Note that trends may appear skewed in FY 91 due to Operations Desert Shield/Storm.

Selected accident briefs

Analysis of Class A-C fixed wing accidents from FY 89 through FY 93 identified the following as the three types of accidents occurring most frequently:

- Collision with ground or water
- Spin/stall
- Wheels-up landings

Collision with ground or water

Scenario 1. The PI was executing a single-engine-out emergency procedure in a U-21A during an

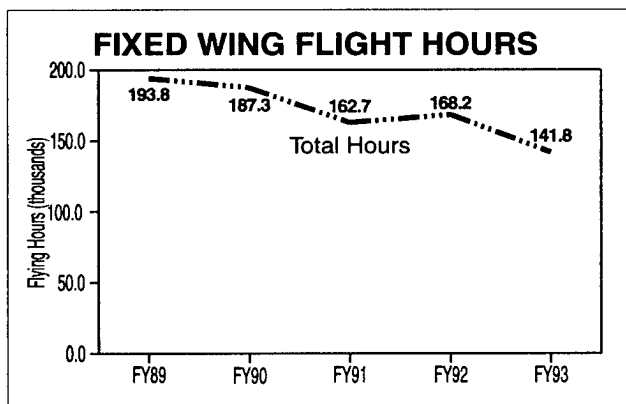


Figure 9-1

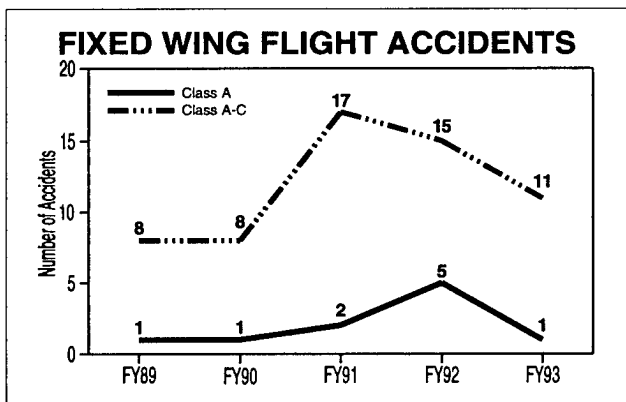


Figure 9-2

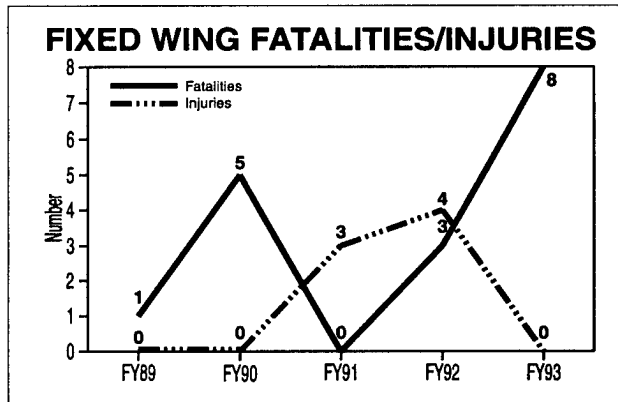


Figure 9-3

annual proficiency and readiness training (APART) evaluation. On climbout, after a no-flap, touch-and-go landing, the IP initiated a simulated single-engine failure. At 225 feet AGL, the aircraft yawed left and pitched slightly nose high. The aircraft continued to yaw and roll left at about 70 degrees angle of bank while descending. The aircraft struck the ground at about 90 knots, approximately 15 degrees left wing low and 10 degrees nose low. The aircraft slid approximately 160 feet before coming to rest in an upright position.



■ **Result:** Two injuries, a destroyed aircraft, and a cost of \$621,366.

■ **Cause:** The PI was slow to recognize uncoordinated flight and to take timely corrective action. The IP was slow to recognize the PI's failure to maintain coordinated flight and take corrective action.

■ **Crew experience:** The IP had 6,063 hours of flight time, 927 in U-21As. The PI had 534 hours of flight time, 63 in U-21As.

Prevention techniques and procedures: The PI had completed this maneuver earlier in the training period, but it was at a higher altitude. By adequately demonstrating his proficiency, he reinforced the IP's overconfidence in his ability to do it again. Even the best pilot makes mistakes, as this case proves. "Never allow the pilot to exceed his limits" has been around on the flight line probably since the birth of aviation. This doesn't mean the limits of his ability to fly the machine; rather, it means the limits of his ability to perceive the problem, decide upon a course of action, and react within the limits of his ability to fly the machine. There is a vast difference.

Scenario 2. The C-12F crew's preparation and departure for an IMC/IFR flight revealed that they were in a hurry. Later, the crew reported a

final approach fix inbound on instrument approach. As the aircraft continued a descent for landing, it impacted a snow-covered mountain at 2,300 feet MSL.



■ **Result:** Eight fatalities, a destroyed aircraft, and a cost of \$5,192,539.

■ **Cause:** The crew failed to follow published procedures for the intended approach and misidentified the aircraft's position on the approach. The aircraft was reported at an intersection inbound approximately 20 miles short of where the aircraft actually was. The aircraft descended out of altitude and went below the approach segment minimum altitude and impacted the mountain.

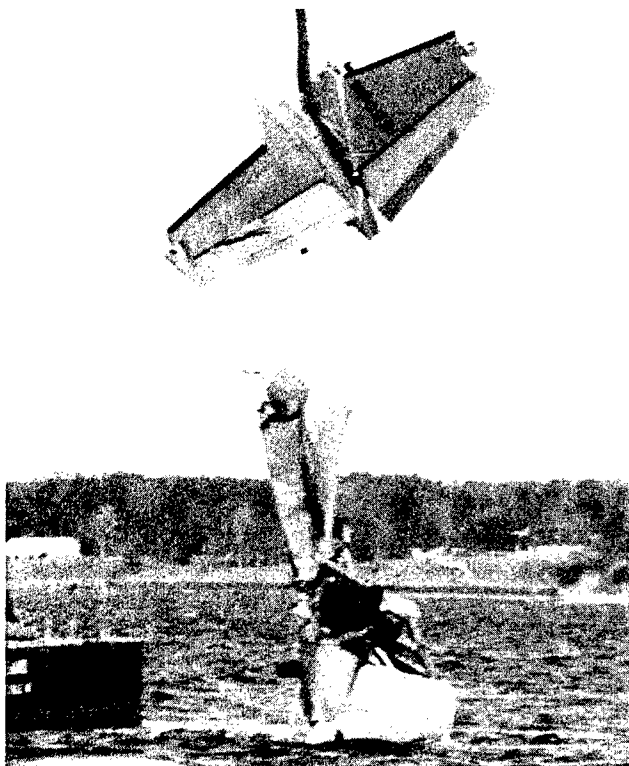
■ **Crew experience:** The PC had 5,369 hours of flight time, 245 hours in C-12Fs. The PI had 6,718 hours of flight time, 2,345 in C-12Fs.

Prevention techniques and procedures: When a mission isn't coming together, try to step back and look at it objectively. If you feel uncomfortable about some aspect of a mission, talk about your concerns. Crew coordination *must* take place when operating in IMC conditions. Continue to validate your position. Always know where you are. Employ your navigational instruments properly. Cross-check, cross-check, cross-check.

Spin/stall

Scenario 1. The CASA C-212 was established on a left downwind at an altitude of approximately 1,200 feet MSL and a ground speed of approximately 120 knots. The airplane was observed to abruptly roll right approximately 60 degrees, pitch nose down approximately 80 degrees, and crash into a river.

■ **Result:** Five fatalities, a destroyed aircraft, and a cost of \$8,651,210.



■ **Cause:** The most probable scenario for this accident is: While attempting to descend to 500 feet MSL, both power levers were mistakenly retarded and the right power lever was placed in the Beta range. When the error was noticed, both power levers were advanced. But because the power levers were not symmetrical—the left was at idle and the right was in Beta—the left propeller immediately began producing thrust while the right propeller continued to produce drag. This asymmetrical thrust condition caused the aircraft to abruptly roll right and resulted in loss of aircraft control at an altitude that made recovery impossible in time to prevent impact.

■ **Crew experience:** The PC had 6,675 hours of flight time, 106 in C-212s. The PI had 7,550 hours of flight time, 159 in C-212s.

Prevention techniques and procedures: A Notice of Proposed Rule Making (NPRM, Docket No. 90-NM-17-AD) has been issued. This NPRM requires modification of the propeller speed and pitch control system to prevent movement of the propeller speed and pitch control system into reverse thrust during flight.

Scenario 2. The aircrew was conducting a maintenance test flight on a U-21A. During performance

of a landing-configuration stall, the aircraft rolled right, then rolled left and entered a spin. The spin and resulting recovery overstressed the aircraft, and the left wing, left elevator, and nose-gear doors were damaged.

■ **Result:** Damage cost of \$28,792.

■ **Cause:** While attempting to recover from a landing configuration stall, suspect the pilot overcorrected the aircraft when it initially started a right roll. This overcorrection caused the aircraft to enter a left roll. The left roll was so severe that further control inputs were ineffective because of the slow airspeed of the stalled airfoil.

■ **Crew experience:** The MP had 6,391 hours of flight time, 513 in U-21As. The PI had 10,424 hours of flight time, 486 in U-21As.

Prevention techniques and procedures: Follow procedures outlined in FC 1-218: Aircrew Training Manual, Utility Airplane, Task 1014 for performing a stall. FM 1-203: Fundamentals of Flight also describes this maneuver.

Wheels-up landings

Scenario 1. The aircrew was conducting a training flight in an RC-12H. During the roundout for a power approach precision landing the crew heard an unusual scraping and ticking sound and noticed the aircraft fuselage was closer to the ground than it normally would be. Sheet metal on the underside section of the fuselage was damaged when it contacted the runway, engines received sudden stoppage damage, and all of the propeller blades were damaged.



■ **Result:** Damage cost of \$274,608.

■ **Cause:** The IP failed to follow procedures. He did not orally call out checklist items and ensure that actions were verified by using the

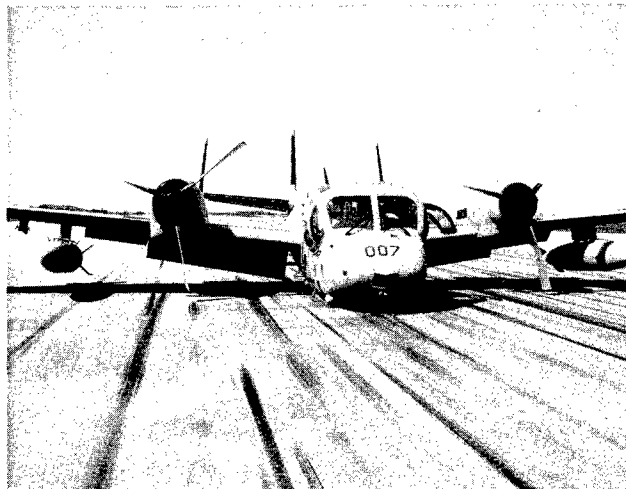
pilot's checklist. As a result, the landing gear was not extended during the before-landing check, and illumination of the landing-gear-down indicator lights was not verified during the landing check.

■ **Crew experience:** The IP had 7,775 hours of flight time, 278 in RC-12Hs. The PI had 5,190 hours of flight time, 163 in RC-12Hs.

Prevention techniques and procedures: The dash 10 requires that checklist items be called out orally and actions verified using the pilot's checklist. Upon completion of each checklist item, the pilot not on the controls will advise the pilot on the controls that the checklist item called for has been completed. Following procedures will prevent accidents.

Scenario 2. The crew was performing an RL3 training flight in an OV-1D. While on downwind, the IP simulated failure of the No. 1 engine by reducing the No. 1 engine power lever. The IP announced the engine failure and told the PI to continue the pattern and perform a simulated single-engine landing. The PI continued with a normal pattern. As the aircraft approached the landing runway, the PI and IP noted that the flaps were at zero degrees. The PI applied full flaps. As the flaps extended to full-down position, the aircraft "ballooned." Both pilots had their attention

on the landing attitude of the aircraft. The aircraft continued to the touchdown point and landed gear up.



■ **Result:** Damage cost of \$5,879,892.

■ **Cause:** The IP failed to verify that the PI completed the before-landing or landing check. The IP was preoccupied with another aircraft in the traffic pattern and the change in attitude of his own aircraft during the final landing phase.

■ **Crew experience:** The IP had 6,771 hours of flight time, 1,829 in OV-1Ds. The PI had 777 hours of flight time, 94 in OV-1Ds.

Prevention techniques and procedures: Same as Scenario 1.
