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FLYING Safety

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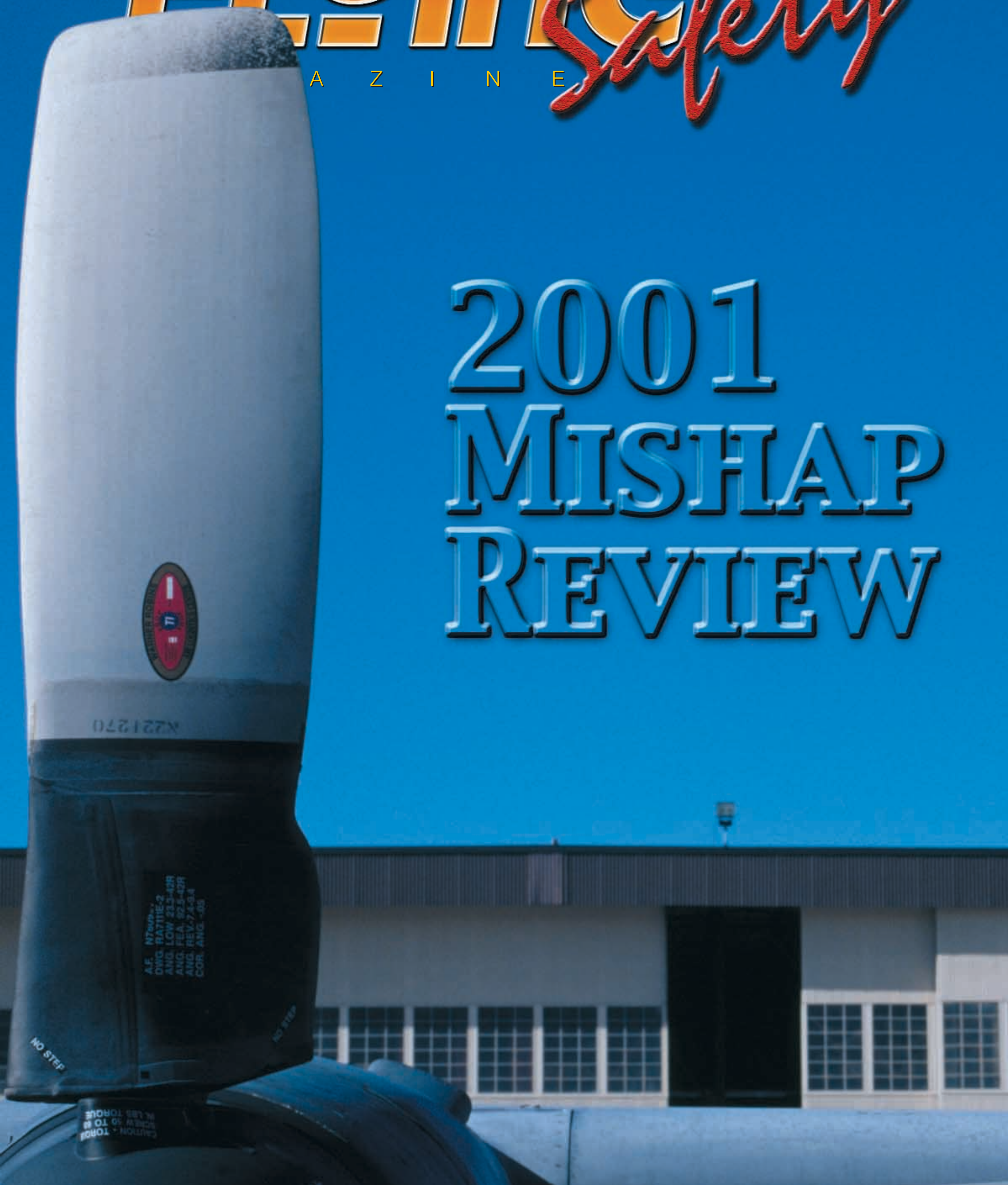

2001 MISHAP REVIEW

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UNITED STATES AIR FORCE

FLYING Safety MAGAZINE

This Issue:

NOTE: Due to space limitations, the U-2 end-of-year mishap summary will appear in the next edition of Flying Safety.

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MESSAGE From the Chief of Safety

SAFETY POLICY IN A COMBAT ENVIRONMENT

Prior military experience has taught that an aggressive safety program is as essential to the preservation of our combat potential in war as in peace, and we cannot unnecessarily compromise safety to accomplish our mission. Although the course of any armed conflict may require some adjustments to meet operational requirements, present military operations…have proved that any degradation of emphasis on safety will result in needless loss of personnel and equipment.

We now have the weapons systems, the personnel and are are rapidly acquiring the facilities which we need to most effectively accomplish our mission, but conditions keep changing, and with them, the task before us. This means we must stay flexible enough to adapt ourselves to any new problems that may arise. This flexibility rests primarily with our personnel. It is up to us to make the best possible use of our equipment and organization under changing conditions.

My commanders are the prime factors of our safety program, for they set the pace and bear the burden of responsibility. This responsibility also extends downward and includes each supervisor, as well as every individual. As the risks associated with our combat operations increase, so must the degree of our supervision. Only the supervisor who recognizes safety as an integral part of his management responsibility can be truly effective. Therefore, safety must be integrated into every phase of operations, maintenance and support activities.

A review of our accidents…during the past year reveals that many may have been attributable to the hazards associated with the combat environment. However, some of them indicate lack of command attention, weak supervision, or lack of self-discipline. To ensure continuation of our present favorable safety trends, I insist that each commander and supervisor continually emphasize the necessity for a strong accident prevention program based on quality supervision and adherence to published directives.

Sounds like I wrote those words just today, doesn't it? In fact, they were written by the then-Pacific Air Forces Commander, General John D. Ryan, in 1967, in reference to combat operations during the Vietnam War. But as we conduct combat operations in an ongoing war against terrorism today—and make no mistake, it is *war*—General Ryan's words ring just as true now as they did then: "… Any degradation of emphasis on safety will result in needless loss of personnel and equipment."

Let me state one point loud and clear: The rules, regulations and tech orders we use in wartime are the very same ones we use during peacetime. While combat operations may require exercise of a greater degree of personal initiative to meet unexpected or changing mission requirements, combat operations also demand even greater use of risk management than peacetime operations. We don't throw the rules out and cut corners for the sake of expediency. Unauthorized deviations from tech data are a sure way to hurt people, damage equipment and jeopardize the lives of others.

It makes absolutely no difference whether you're a Senior Airman crewing a tanker, a Lieutenant flying an F-16 or a Tech Sergeant performing barrier maintenance. It is incumbent upon every single one of us, *regardless of rank or AFSC*, to follow tech data, correct someone who doesn't and, most importantly, understand that safety is an *enabler*, *not* an impediment.

Safety is the linchpin that preserves combat capability and prevents casualties.

Major General Timothy A. Peppe
USAF Chief of Safety

F-16

MAJ PABLO "CHOLO" SANCHEZ
HQ AFSC/SEFF

We suffered six fatalities and lost 14 F-16s in 13 Class A Mishaps in FY01.

Whether it's peacetime or wartime, the F-16 community seems to insist on distributing the most airplane parts. FY01 has been no exception. After a rather impressive year in FY00, we have returned to a higher mishap rate that's more in line with historical data. This past year we turned a mishap rate of 3.83 per 100,000 flight hours, while flying on the order of some 340,000 hours. The F-16 was involved in half of the USAF's 26 Class A Mishaps for FY01 (*since revised downward to 24. Ed.*).

Rather than getting bogged down in the minutiae of the lower-level incidents, suffice it to say that the F-16 continues to experience its share of Class Cs, Es and HAPs *(High Accident Potential. Ed.)*. This article focuses mainly on Class A and B mishaps. Keep in mind that the following data is derived from *non-privileged* reports. For more *detailed* information, visit your unit safety shop. Also, for expanded information regarding the engine mishaps, please see the FY01 Engine-Related Mishap Summary elsewhere in this issue (*See page 42. Ed.*). Following is a brief synopsis of the individual Class As.

Class A Mishaps

We suffered six fatalities and lost 14 F-16s in 13 Class A Mishaps in FY01. Seven involved engine problems. There were also two midair collisions (loss of three F-16s), one controlled flight into terrain (CFIT), one bird strike, one G-induced loss of consciousness (GLOC), and one involving spatial disorientation. Here are the summaries.

- F-16C Engine Malfunction (GE-100). During the third engagement of an ACM sortie, the mishap pilot (MP) selected afterburner, experienced airframe vibrations and a loss of thrust. After an unsuccessful airstart, the MP safely ejected.
- F-16DG Engine Malfunction (PW-220). Ten and one half minutes after takeoff, during the low-level portion of a continuation training Surface Attack Tactics sortie, the mishap aircraft (MA) began to shake violently. The MP zoomed the aircraft as thrust decreased. When fire began to stream from the tail section, the MP initiated a successful ejection, sustaining only minor injuries.
- F-16CG Engine Malfunction (GE-100). The MP was flying in support of an Operation NORTHERN WATCH mission. Thirty-five minutes after takeoff, the MA encountered engine problems. After multiple unsuccessful restart attempts the MP initiated a successful ejection.
- F-16B CFIT. The MA was flying a Safety/Photo chase mission for a test program. The mishap crew (MC) consisted of the MP, an F-16 experimental

test pilot, and a civilian contractor aerial photographer. During the chase profile of the mission, the MA impacted the ground, killing both crewmembers.

• F-16CJ GLOC. The mission was briefed as a Mission Qualification Training, High Aspect BFM sortie for the MP. During a 2.5-mile offensive perch setup, the MP experienced GLOC. The MP regained consciousness and initiated ejection at a high rate of speed and low altitude, resulting in fatal injuries.

• F-16CG Spatial Disorientation. The MP was flying as number two in a 2v2 intercept mission as part of his night vision goggle (NVG) upgrade program. While established in military training airspace at approximately 20,000 feet, the flight lead initiated a left-hand turn. Flying in NVG fluid formation, the MP started a left roll to follow flight lead's aircraft. The MP channelized his attention, which resulted in incapacitating spatial disorientation. For the next 23 seconds the MA continued rolling slowly to the left while the nose dropped, eventually establishing a steep, inverted, diving flight path. Passing 13,000 feet, the MP began making erratic control inputs characterized by rapidly alternating left and right rolls and G forces varying between two and eight Gs. Thirteen seconds after commencing the erratic control inputs and one second prior to impact, the MP initiated ejection outside the survivable envelope of the ACES II ejection system and sustained fatal injuries.

USAF Photo

• F-16CJ Engine Failure (GE-129). The MP was number two in a two-ship formation Mission Qualification Training sortie. While executing a visual, level delivery weapons delivery pass on a conventional bombing range, the MP reported an engine problem. While turning toward home station, the MP attempted an unsuccessful airstart. The engine would not start due to catastrophic failure of the engine case. Approximately 70 seconds after reporting the initial problem, the MP successfully ejected and parachuted to safety with minor injuries. The MA was destroyed.

° Inspection of the engine revealed FOD to one of the blades in the 3rd stage compressor. The time that the damage occurred could not be determined. The damage went undetected long enough for a fracture to develop and, on the day of the mishap, the fracture propagated to such a point that the blade failed through tensile overload (it broke). The blade was liberated and, as luck would have it, lodged in the compressor section. A titanium fire resulted from friction and created a burn-through of the compressor casing. The resulting breach in the compressor case prevented normal engine operation and ultimately precluded a successful restart.

• F-16B Bird Strike. During a two-ship training mission on a conventional bombing range, the MA flew through a flock of birds and ingested at least one bird into the engine. The MP declared an emergency and turned towards a local divert field. As a result of the bird strike, the engine suffered major damage including damaged blades, a punctured oil tank and broken fuel lines. Despite the damage, the engine continued to operate well enough to allow a safe landing at the divert field. Upon clearing the runway, the MP stopped the jet to await fire department personnel.

° Unbeknownst to the MP, a large fuel leak began to develop under

continued on next page

For the next 23 seconds the MA continued rolling slowly to the left while the nose dropped.

The MP made three airstart attempts, all of which were unsuccessful.

the aircraft. The responding crash crew noticed the fuel leak and attempted to marshal the MA away from it prior to shutdown. As the pilot pushed the throttle up to move the aircraft forward, a compressor stall occurred and engine RPM began to decay. The MP immediately shut off the throttle, which resulted in fuel dumping underneath the MA. The wind sprayed the dumped fuel mixed with the leaking fuel onto the left brake resulting in a fire that quickly spread to the fuel puddle on the ground.

° The mishap crew ground egressed uneventfully and the fire department extinguished the fire within approximately 10-15 seconds. Unfortunately, the damage caused by the bird strike combined with the fire damage resulted in Class A costs for this mishap.

• F-16C Engine Failure (GE-100). The MA was on the second sortie of the day after a hot pit refueling. The MP was number two of a four-ship formation scheduled for a low-altitude intercept mission. During the G-awareness exercise, approximately seven minutes after takeoff and passing 14,000 ft MSL (10,000 ft AGL), the MP heard a loud bang. The MP rolled out of the turn, heard a few more loud bangs and observed RPM rolling back. The MP made three airstart attempts, all of which were unsuccessful. The MP successfully ejected between 1000-1200 feet AGL.

° Post crash examination of the MA and engine indicated a No. 3 engine bearing cage fracture which led to a complete failure of the No. 3 main thrust bearing. This failure, in turn, led to a rearward shift of the compressor, causing blade-to-vane contact, fire and, ultimately, engine seizure.

• F-16C Engine Malfunction (GE-100). The MA was operating as part of a routine, four-ship, Dissimilar Air Combat Training (DACT) sortie en route to an over-water range. During departure, the MP experienced a loud bang and violent shudder in the MA. The MP initiated a return to base and began Critical Action Procedures for engine failure. Flight lead notified the MP he was on fire and trailing a 50-foot flame. After visually verifying that he was on fire, the MP initiated a successful ejection.

° The MA impacted the water and was never located, despite extensive salvage efforts. Although the available evidence clearly supports a catastrophic engine failure and associated fire, there was insufficient evidence for the AIB president to determine the cause of the accident or any substantially contributing factor.

• F-16CG/Cessna 172 Midair Collision. MP1 was the F-16 wingman on a two-ship, low-level, Surface Attack Tactics sortie. MP2 was a civilian operating a Cessna 172 under Visual Flight Rules but following radar vectors from Approach Control. Shortly before the midair collision, the F-16 flight had cancelled IFR and descended under VFR toward the published low-level entry point. However, the lead F-16 had developed a 9-11 mile position error in his INS. Flight lead didn't recognize this error and unknowingly led his flight into controlled airspace where the Cessna was operating. The F-16 flight and the Cessna were on a collision course, but none of the pilots recognized it in time to avoid the collision. MP2 suffered fatal injuries; MP1 ejected successfully.

° A combination of factors led to this mishap. First, a loss of Situational Awareness and a failure to recognize a position error led the F-16 flight to penetrate Class B airspace without clearance. Second, all pilots failed to see and avoid each other. Finally, Approach Control failed to transmit a safety alert to the Cessna when their radar system generated "Conflict Alert" warnings.

• F-16CJ/F-16CJ Midair Collision. The mishap aircraft were number one and number two respectively in a four-ship DACT sortie participating in an over-water air defense exercise. En route to their assigned Combat Air Patrol point, the flight initiated a 90/180 air-to-air G-awareness maneuver. Beginning from a Spread 4 formation, and following a 90-degree in-place turn to the right, the formation rolled out in trail with each other—number 4 in the lead, then number 3, then MP1 and MP2 last. MP1 directed an in-place 180-degree turn to the left. After approximately 13 to 14 seconds in the turn, MA1 and MA2 collided. Both aircraft sustained major damage in the collision and were uncontrollable. MP2 successfully ejected from his aircraft 15-18 seconds following the collision and parachuted safely to the ocean. None of the pilots in the mishap flight observed MP1 eject from his aircraft and he was declared lost at sea after an extensive search. Neither aircraft was recovered from the ocean.

° Again, several factors contributed to the mishap. MP1 failed to visually acquire MA2 during the 180-degree turn and deconflict their flight paths. Also, MP2 failed to maintain adequate distance between his aircraft and MA1 before the start of the 180-degree turn, causing a flight path conflict that MP1 may not have expected. Finally, the 180-degree G-awareness turn from a visual, in-trail formation did not provide adequate flight path deconfliction opportunity for either mishap pilot.

• F-16CG Engine Failure (PW-220). The MP was part of a 2v4 air-to-air continuation training mission. Twenty-eight minutes after takeoff, and following the first engagement, the rear, inner race of the mishap engine's No. 3 bearing fractured, causing a catastrophic failure of the No. 3 bearing. At 18,000 feet MSL and 290 knots, the MP experienced severe engine roughness and an audible bang, followed by rapid engine RPM decay and engine failure. The MP immediately turned the aircraft toward the closest emergency airfield, which was beyond safe gliding distance. Following two unsuccessful engine restart attempts, the wingman reported the MA on fire and the MP safely ejected.

° The No. 3 bearing assembly was damaged during depot-level maintenance build-up, resulting in failure of the bearing's rear, inner race during engine operations. Ultimately, the bearing race failure resulted in complete bearing assembly failure and engine seizure.

Significant Class B Mishaps

Air Force Safety Center stats show twelve F-16 Class B Mishaps logged for FY01. Not all are listed here, but I have included a few of the more noteworthy ones that warrant discussion. As noted before, more detail on these mishaps can be acquired through your local safety shop.

• F-16C/F-16D Midair Collision. The mishap sortie was a night, four-ship, tactical intercept mission, planned as part of the squadron's NVG upgrade program. The flight lead and number two collided during a fluid turn in the CAP, prior to start of the first intercept. Both aircraft were moderately damaged but recovered safely.

• F-16CJ Electrical Malfunction. The MP returned to base from an otherwise uneventful sortie with what he thought to be simple main generator failure. Postflight inspection, however, revealed extensive fire damage throughout the right leading edge flap, to include burned wire harnesses, bus contactors, over-current sensing contactors and a generator control unit. In addition, significant heat buildup damaged wing fuel cell seals, requiring a wing replacement.

• F-16CJ Engine Flameout (GE-129). MA was part of a deployment en route to an overseas location. During non-maneuvering flight at FL250, the MP's wingman noticed a small amount of vapor streaming from the lower, aft portion of the MA. Fluctuating oil pressure was noted during flight and the MP decided to divert to a nearby base. The MP anticipated the possibility of an engine flameout and established a 1:1 glide path. Upon gear extension and an increase in throttle position, the mishap engine flamed out. The MP executed a successful flameout landing and no further damage was incurred.

Common Threads

The main points I'd like all Viper drivers to ponder are manifest in the aforementioned mishaps. Pilots on the line continue to do world-class work when they encounter emergency situations. Whether it's a system malfunction or an external anomaly such as a bird strike, pilots are making good decisions and saving valuable assets (primarily themselves!). Handling emergencies successfully is a direct reflection on EP training. Habit patterns instilled through the practice of methodical, well-thought-out procedures keep us safe.

There are a couple of disturbing trends reflected in this year's mishaps which I believe need to be addressed from the training aspect. Those are in the areas of midair collisions and NVG incidents.

• Midair Collisions

The Viper community has been plagued in recent years by a "negative learning curve" in the area of midair collisions. Table 1 illustrates that since passing the 700,000-hour mark (calendar year 1985) we began experiencing an upward trend in the midair collision attrition rate per 100,000 hours flown.

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Significant heat buildup damaged wing fuel cell seals, requiring a wing replacement.

Resource information courtesy of Lockheed Martin Aeronautics Company

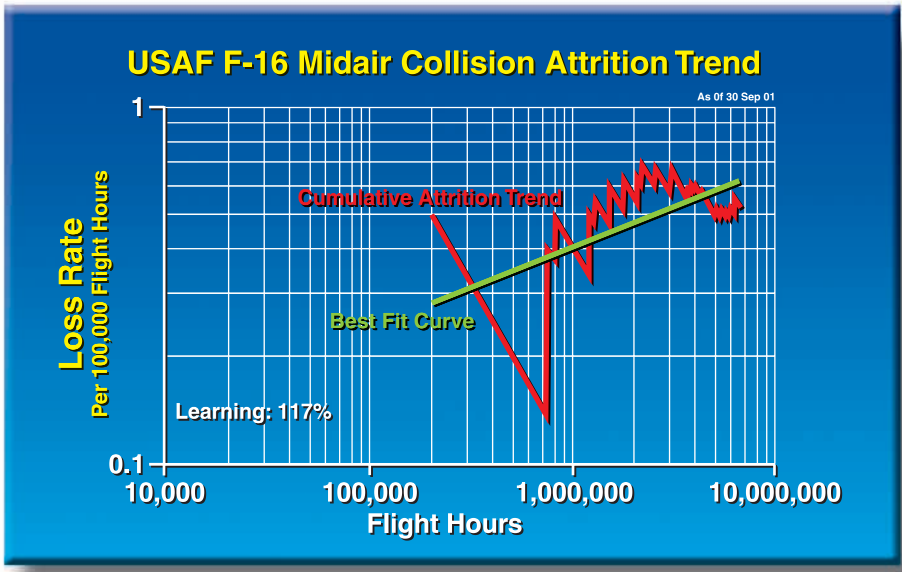


Table 1

The vast majority of midair collisions occur between similar type aircraft.

While the midair collision loss rate has decreased slightly since passing 3,000,000 cumulative flight hours—a very good thing—it's still much higher than it should be for a mature weapon system like the F-16.

Most learning curves show a positive (or downward) trend as the system matures. So why the increase in midair collisions recently? Some people say it's due to a downturn in experience level in the operational force. Others claim that pilots are mis-prioritizing their attention, placing it on cockpit sensors instead of looking past the glare shield.

Statistically, it's important to note:

- The vast majority of midair collisions occur between *similar type aircraft;* and
- *Between members of the same flight.*

Indeed, the preponderance of the midair collisions happen in the ACBT regime between members of the same team who are working against a common adversary. Many also occur during non-tactical portions of the mission, such as rejoins or (as in the case of the Class B) during marshalling.

Several technological solutions are in the works including the development of a midair collision avoidance system for fighters. In the meantime, and ultimately however, the solution lies in training. Habit patterns must be taught and reinforced which bring the pilot's cranium outside the cockpit while operating in close proximity to other aircraft. The same methodical practice of well-thought-out procedures can help us preclude a midair incident.

- NVG Incidents

In the last decade, the fighter community has moved toward tactical dominance of the nighttime arena. Technological advances have allowed us to take our "day VFR" fighter and make it a highly credible night asset. We are now performing complex night missions that were unthinkable before Desert Storm. This is largely due to the implementation of night vision goggles.

The increase in NVG use has also, unfortunately, led to an increase in NVG mishaps. Many of these mishaps have taken place during NVG upgrades, and nearly all have their roots in human factors issues. Primarily, we have seen that NVG use can instill a false sense of security, which can insidiously lead to spatial disorientation.

Again, it is my assertion that habit patterns instilled through methodical training practices will help the upgrading pilot preclude a mishap situation. Recently, the lead night training squadron, the 310 FS at Luke, implemented a Night Systems Course combining both the MANTIRN and NVG syllabi. Hopefully, a strong initial training program for night operations, paired with comprehensive follow-on upgrades in the operational commands will mitigate—dare I say, eliminate?—future mishaps.

FY01 wasn't the best of years. FY02 meets us with greater challenges in the operational context. Every training sortie counts and every asset—especially you!—is important to meet the challenges ahead. Keep it safe and keep 'em flying.

A-10

USAF Photo

MAJ NATE KELSEY
HQ AFSC/SEFF

The venerable A/OA-10 continues to boast superb safety numbers. Two Class A mishaps combined with zero fatalities over 112,088 forecasted flying hours for FY01 invites envy from all the other fighter/attack weapon systems. As I write about our fiscal year mishaps, I'll review the more significant Class A, B, C and HAP events.

No one trend stands out. Some of you flying the Hog are getting some relief from the NVIS mod in regards to past ADI woes, while lack of parts continues to frustrate some units. There have been quite a few mishaps involving smoke or fumes in the cockpit from various sources. A few cats and dogs with the engine but, hey, it's nice to have two of them! Tends to keep the Class A numbers down, doesn't it?

As long as we're flying low, we'll continue rejoin on our feathered friends with too much closure and "some" overtake. A fellow Hog driver dragged one in a little bit when he hit a tree during an approach to landing. If VASIs were available they should've been in the cross check.

In another incident, I don't know how a pilot could confuse HEI with TP, but one of our bro's did just that and used that ammo improperly. As with all mishaps, there was a chain of events, and in this one, there were several members of the team who could have broken it. In most cases the final link is YOU, the pilot. And, no, he didn't break it this time either, because you know what else happened? He was "in a hurry." Remember, let's slow down and get there twice as fast. You might think this is just another case of monochromatism, but it isn't. (You better go look that one up.) *(We'll save you the trouble. It's a defect of vision in which the retina fails to perceive color. Ed.)* Preflight at dusk/night without using a flashlight… extremely hard to tell the color code of ammo. Couldn't happen to you? Probably the same thing this guy *used* to say.

One of the two Class As this year hasn't been briefed, so all I can say is this:

The aircraft was part of a three-ship cross country flight. Area weather was clear. Approximately 30 minutes after takeoff, the pilot ejected safely and the A-10 impacted the ground.

But I can talk about the other. The mishap took place during the final approach and landing phase. You know, that part we all seem to gloss over during the brief? I mean, it is the easiest part of the sortie, right? Well, during this CAS training sortie, the Mishap Pilot (MP) initiated an early RTB and shut down the No. 2 engine IAW Dash-1 procedures due to an oil problem. On final approach, the MP experienced the aircraft's stall warning several times and adjusted his control inputs by relaxing back stick pressure. This led to the aircraft descending below desired glideslope. The stall warnings were caused by the MP's failure to apply sufficient rudder to sustain coordinated flight. The MP was uncomfortable with this condition and initiated a go-around. After he placed the throttle to max and cleaned up the gear, the aircraft's yaw increased and it started to stall. The MP felt the aircraft was out of control and initiated a successful ejection. The aircraft was destroyed on ground impact. The bottom line is the pilot failed to maintain control of the aircraft while executing a single-engine go-around, resulting in the aircraft departing controlled flight, followed by pilot ejection.

You might want to think about how you fly your next simulated single-engine approach. Maybe that one you thought was good enough… really wasn't.

Now, my challenge to you is this: Quit giving me things to write about! Human error still accounts for the majority of all accidents. I know you'll come back with the old "Ops Tempo" and "doing more with less" spiel, but who's going to call the knock-it-off if you don't? Remember, you're the last link in the chain the majority of the time.

I've flown fighters since '87, and the hardest thing to keep in the forefront of your mind is this: You never know when you'll get the opportunity to demonstrate your depth of knowledge of the Dash-1, emergency procedures and/or a PLF. Think about what you're doing and why you're doing it. Now, go out and do what Hogs do best.

I'll leave you with a quote from Suzuki: "In the beginner's mind there are many possibilities, but in the expert's mind there are few." That's all for now.

C-135/KC-

The sine wave broke off the receiver's refueling probe and caused failure of the drogue basket coupling.

MAJ PHIL SCHROEDER
HQ AFSC/SEFF

FY01 was another good year in the C-135 and KC-10 community. As of this writing, the trend continues with no loss of life and no destroyed aircraft. Well Done! With Operations ENDURING FREEDOM and NOBLE EAGLE now in full swing, the air refueling business is busier than ever, so keep your heads up. Be smart. Plan accordingly. Let's continue the trend that has been established.

Because of safety privilege, it's often difficult, if not impossible, to discuss details and causes for many mishaps, particularly in a public forum like this. I encourage you to visit your local Flight Safety Office folks and take a look at the mishap messages related to the following accounts, so that you can learn from them and avoid similar events yourselves.

C-135

The C-135 did not experience any Class A Flight Mishaps, although a seven-inch pair of diagonal cutters left in an engine during a ground maintenance run resulted in a Class A Ground Operations Mishap. There were a variety of mishaps in the other classes. The uncommanded horizontal stabilizer trim saga continues for the C-135.

Most of the Class B mishaps involved aircraft engine damage.

- While taxiing for departure, the No. 4 engine stall light illuminated, followed by an EGT rise. The aircrew shut down the engine, restarted it and continued the mission. At the power reduction for level-off, the No. 4 engine started shuddering and fuel flow and RPM rolled back. The engine was placed in idle and the mission terminated. The engine suffered compressor damage.
- On three different sorties, all flown sequentially, the aircraft's No. 2 engine was noted to have higher EGT readings than the other engines, although all EGT readings were in the normal operating range. After the second sortie, maintenance examined the engine and launched the aircraft on the third sortie with the power management control turned off. On takeoff, nearly full throttle was required to reach the reduced takeoff thrust setting. The remainder of the mission was flown as planned. After landing and maintenance inspections, the engine turbine area was found to have Class B damage.
- An aircraft returning from PDM was found to have significant FOD damage in the high pressure turbine section.
- An aircraft's No. 3 engine wouldn't produce the required thrust for takeoff. The aircrew aborted and maintenance performed an engine run that resulted in a compressor stall. Borescope inspections revealed Class B engine damage.
- During a Tornado air refueling using the Multi-Point Refueling System, slack developed in the refueling hose. The reel system didn't take it up in a timely manner and a sine wave developed. The sine wave broke off the receiver's refueling probe and caused failure of the drogue basket coupling,

USAF Photo

which fell to the forest below.

• An unattended, unchocked flightline vehicle, in which the emergency brake was not applied, rolled 500 feet and contacted—what used to be—the No. 1 engine tailcone assembly.

There were assorted Class C mishaps.

• An RC-135 experienced No. 4 engine rollback shortly after takeoff. The engine had to be shut down because of turbine blade failure.

• A KC-135 engine over-temped during takeoff and climbout.

• Landing in crosswinds and scraped engine pods accounted for two Class C mishaps.

• On approach to home station, in clouds, at the freezing level, with precipitation, a lightning strike zapped a KC-135.

• Another aircraft suffered Class C lightning strike damage while attempting to navigate between two heavy rain showers while being vectored for an approach at home station.

• An APU was damaged during preflight when the turbine wheel seized.

• While performing a practice emergency separation during air refueling, the tanker autopilot disconnected, the aircraft pitched up abruptly and stab trim began running rapidly in the nose up direction. The horizontal stabilizer brake wasn't functioning properly.

• During an air refueling mission, the pilot director lights showed "A" for "Aft," meaning the receiver should *move aft*. The receiver pilot interpreted the lights as "I'm Aft" and needed to move forward. The boom operator's "Back Four" calls did not register with the receiver pilot. A breakaway was initiated before the separation was complete and the boom ice shield was damaged.

• Another ice shield got damaged when, during a night air refueling mission with reduced visibility and light turbulence, the receiver approached the inner air refueling limit.

• A receiver pilot became erratic within the air refueling envelope and the boom operator initiated a breakaway. However, the receiver hit an aft limit, resulting in a brute force disconnect.

• During an E-3 refueling, headed into the sun, the receiver approached an inner limit. The receiver pilot didn't respond to the boom operator's verbal corrections. The boom operator attempted a disconnect. However, due to forward movement of the receiver, the boom nozzle was unable to be retracted from the receptacle. Prior to disconnect, the receiver contacted the ice shield.

The majority of the C-135 HAP events involved the horizontal stabilizer trim system.

• On several occasions, during the preflight stabilizer trim check, the stab trim wheel moved when it shouldn't have.

• During another preflight stabilizer trim check, the stab trim wheel didn't move when it should have.

• The stabilizer trim auxiliary brake failed during a routine maintenance check and needed to be replaced.

• One crew experienced uncommanded horizontal stabilizer trim movement during taxi for takeoff.

• During level flight at cruise, there were two separate instances of uncommanded horizontal stabilizer trim movement.

• While leveling off from a descent, neither the pilot nor copilot stab trim switches would trim in the nose up direction; both switches functioned properly for nose down trim.

• On approach, using the electrical stab trim switches on the yoke, an aircrew experienced the trim control wheel moving or coasting an additional three to four revolutions immediately following a commanded trim movement.

• During climbout following a touch-and-go landing, an aircrew experienced uncommanded horizontal stabilizer trim movement.

continued on next page

Due to forward movement of the receiver, the boom nozzle was unable to be retracted from the receptacle.

The KC-10 receiver pilot triggered a disconnect, but nothing happened.

• On another sortie, the horizontal stabilizer trim couldn't be reset following a touch-and-go landing.

Failure of the stabilizer trim actuator electrical drive unit was found to be the problem on some of the above sorties. On a few mishaps, electrical connections weren't properly soldered. The stabilizer trim issue is on the minds of C-135 aviators as well as senior Air Force leaders. Changes to stabilizer preflight procedures have been incorporated in the Technical Orders. Aircrews have been trained in the simulator to correctly react to a stabilizer trim malfunction. Engineering solutions are being worked. Continue to keep the stabilizer trim issue a part of mission planning and everyday flying.

The C-135 also experienced HAP events not related to uncommanded horizontal stabilizer trim movement.

• While refueling an F-18 using the boom drogue adapter kit, the boom operator was unable to get a successful disconnect. As the receiver backed away, the refueling hose began to unravel, eventually separating the drogue from the receiver's probe. The drogue remained attached to the tanker via the unraveled refueling hose.

• During another air refueling, a Tornado became thrust-deficient. To compensate, the Tornado pilot put one engine in a partial afterburner setting. Still thrust-deficient, the receiver asked for a "toboggan" maneuver (200-300 fpm descent). Shortly after initiating the descent, the Tornado developed excess closure and tore the drogue assembly from the tanker's boom.

The C-135 suffered numerous Class Es dealing with smoke and fumes.

• On two different occasions, water-saturated or dirty separator socks in the environmental control system helped generate smoke and fumes.

• An air cycle machine failure and an over-serviced hydraulic system leaking into the bleed air duct on another aircraft were the source of smoke and fumes on a couple of other sorties.

• The source of smoke and fumes on one mission was undetermined.

• A copilot instrument power supply generator failure and an APU gearbox seal failure (two different missions) resulted in smoke and fumes after engine start, but prior to launch.

• Another Class E occurred when a KC-135 was passing gas to a KC-10. The KC-135 boom operator triggered a disconnect, but nothing happened. The KC-10 receiver pilot triggered a disconnect, but nothing happened. The adrenalin began to build. The KC-10 initiated a downward forward separation as the boom operator called a breakaway, resulting in a brute force disconnect.

Proper planning and ORM skills are important for mishap prevention. This applies to maintenance crews as well as aircrews. Treat the C-135 with care and let's keep it flying safely.

USAF Photo

KC-10

The KC-10 community experienced two Class A Mishaps for FY01. Both involved ingestion of aircraft fasteners into the No. 2 engine. One of the Class A mishaps was a ground operations mishap and one was a flight mishap. In the first case, a steel aircraft fastener entered the engine during a ground maintenance run. In the second case, abnormal engine indications were noted during flight. It was determined that a fastener entered the engine at an unknown time. In both cases the engine compressor sections suffered extensive damage.

The KC-10 recorded seven assorted Class B mishaps. Here they are, in no particular order.

• In two instances, the TCAS (Traffic Collision Avoidance System) gave a traffic advisory, followed by a resolution advisory directing a climb. In each case the aircrew maneuvered the aircraft accordingly. However, the maneuvering resulted in structural damage to the horizontal stabilizer system of the aircraft.

• In another Class B mishap, a main tire blew and rolled off the rim while the aircraft was lining up for takeoff, causing extensive damage to one of the main landing gear.

• While landing on a wet, slushy runway that had been partially cleared of snow, a KC-10 hydroplaned and came to rest with the right main, center main and nose landing gear off the prepared surface.

• During TCTO (Time Compliance Technical Order) maintenance, a bolt fragment became lodged between turbine guide vanes. At an undetermined time, that bolt fragment dislodged and damaged several turbine blades as it exited the engine.

• An unidentified piece of FOD was ingested into the No. 2 engine and caused extensive damage.

• Shortly after takeoff, part of the No. 2 engine compressor section failed, causing engine damage.

Many of the Class C mishaps in the KC-10 community occurred during air refueling. The sine waves that developed in the following air refueling mishaps occurred during aggressive, firm contacts, as well as during stable, controlled contacts. There were no common trends in receiver pilot technique.

• During a refueling with an F-18, using the centerline drogue system, slack developed in the refueling hose and the reel system didn't take up the slack in a timely manner. A sine wave developed and traveled up to the tanker then back to the receiver. The hose and drogue basket separated when the sine wave returned to the receiver.

• Similar to the F-18 refueling mishap, only this time with an F-14, a sine wave separated the hose from the drogue basket. The drogue basket remained attached to the F-14 refueling probe and eventually became a souvenir on the wall in the navy squadron's bar.

• As an F-14 backed away after refueling, the drogue remained attached to the receiver probe. As the drogue basket and hose separated, the hose unraveled and parts of it struck the receiver. The hose eventually dropped in the water below and both aircraft landed uneventfully.

• A boom operator allowed the reel response system for the centerline drogue system to trail excessive hose, resulting in a sine wave and loss of the drogue basket. As the drogue basket departed, it struck and damaged the F-18 receiver. The F-18 was able to land uneventfully.

• While using the centerline drogue system, a sine wave developed and broke off part of the receiver's probe.

• A wing aerial refueling pod (WARP) would not retract the hose and basket during an air refueling mission. The KC-10 landed with the hose and drogue basket in trail.

• The next mishap occurred as the KC-10 was trailing the WARP system in preparation to conduct air refueling. As the hose was being trailed, a coupling failed and the drogue basket separated from the end of the hose.

• As the WARP hose was being deployed, a spring in the reel response system stuck and the partially extended hose and drogue system would neither retract nor further deploy. The aircraft landed with the equipment in trail.

• Two Class C mishaps occurred when a tow vehicle stopped abruptly. The tow bar shear pins sheared and the tow bar impacted the nose landing gear strut and nose tire.

• While Maintainers were inspecting the No. 2 engine, they discovered that at some unknown time, when the thrust reverser was activated and stowed, the ball-screw mechanism failed and a two-foot section of the thrust reverser was missing.

• Spoilers were damaged during a maintenance check. The spoiler locks were in place (spoilers in the raised position) and hydraulic power was applied but the spoiler handle was not in the "Ground" position. The spoilers attempted to retract with the spoiler locks in place.

• Class C dollar-value mishap damage was discovered during preflight. A wire bundle chafing against a bulkhead led to arcing/burning, which damaged multiple wires in the bundle.

• While attempting to start the No. 2 engine, the aircrew noticed it wasn't rotating. A seal on a vent was not properly bonded to metal, restricting rotation of the core rotor.

• Finally, there was a bird strike that caused Class C damage to the leading edge slat just above the No. 3 engine.

The KC-10 community filed one High Accident Potential (HAP) Report for the past year. On departure, a piece of onboard cargo (a HUMVEE) moved about five feet when the Italian-made Weissenfel™ chain securing it pulled free from the tie-down device.

Overall, well done for the KC-10 community. Keep it up. Be smart. Make mishap prevention an integral part of your cross check. ✈

As the drogue basket and hose separated, the hose unraveled and parts of it struck the receiver.

F-15

The aircraft impacted 17 ducks at an altitude of 650 feet AGL and a speed of 450 knots.

MAJ JASON "DUKE" SMITH
Canadian Air Force
HQ AFSC/SEFF

The mighty Eagle boasted a Class A mishap rate of 1.12 per 100,000 flying hours in FY01, down from 1.67 in FY00. It doesn't take an "Eagle driver" to figure out that there are actually two main reasons for this miserly mishap rate: 1. Pratt and Whitney jet engine; and 2. Pratt and Whitney jet engine. Although the P&W engineer who occupies the cubicle next to mine might argue, it is not the P&W part of this equation that is the most critical, but rather the fact that there are *two* of them.

The *two* GE products that power the venerable F-18 "Hornet" are equally contributory to a low mishap rate, and believe me, I was very conscious of this while patrolling for "Bears" several hundred miles out in the Beaufort Sea. For those of you a little rusty on your geography, that's not only "way up there," but very much in the middle of nowhere! We would say, half jokingly, that the SOP was if you ever punched out, you should save one 9 mm round for yourself instead of using it all for polar bear defense, because no one was likely to rescue you before the cold (or a bear) got you!

Unfortunately, there are several scenarios where two engines are of little help. One is when varied and sundry objects decide to invade the inner workings of *both* engines simultaneously while they are busy converting dead dinosaurs into thrust, and another is unintentional contact with the ground. These two scenarios featured prominently in F-15 Class A mishaps during FY01.

In FY01 there were two F-15 Class A mishaps in which a total of three aircraft were destroyed. While mathematically this all worked out to a mishap rate of only 1.12, tragically, two aviators lost their lives, a fact which greatly overshadows the otherwise enviable numbers. What follows are summaries of the two mishaps.

Mishap 1: Two F-15Cs operating from RAF Lakenheath were overdue to return from a local training mission. The wreckage of both aircraft and the bodies of two pilots were later found in the Cairngorms Mountain Range in the Scottish Highlands. The investigation is still pending.

Mishap 2: An F-15E based at Seymour Johnson AFB was conducting a night, local, Surface Attack Training (SAT-3) mission. The aircraft impacted 17 Lesser Scaup (basically ducks averaging 1.75 lbs. each) at an altitude of 650 feet AGL

USAF Photo

While transitioning to land, one aircraft developed a high sink rate and experienced a hard landing.

and a speed of 450 knots. The right hand engine catastrophically failed and caught fire. The left engine was damaged, as were the right conformal tank, left ramp, navigation pod, targeting pod, left side of the canopy bow and panels 47L and 155L. The crew managed to fly the aircraft back to Seymour Johnson using the damaged left engine, while the right engine continued to burn. The aircraft landed safely and neither crewmember sustained injuries.

Not much in the way of official "lessons learned" can be drawn from these two mishaps, given the pending status of one and the mostly environmental cause factors pertaining to the other. Despite rigorous BASH programs that are in place throughout the USAF, we will continue to have bird strikes, since the "big sky theory" breaks down occasionally as we share airspace with aviators of the feathered variety. We accept this risk to a certain extent, but we are not absolved from continually practicing effective Operational Risk Management (ORM) and adjusting our flying activities accordingly.

Looking deeper into the stats, and taking into account all classes of mishaps and events, there is really only one trend that is readily apparent. While in no way specific to the F-15 community, Human Factors continue to play prominent roles in causing mishaps and events. People continue to make mistakes that result in costly, preventable incidents. What follows is a brief summary of some of the FY01 incidents in which humans were the "weakest link," and rang up some hefty bills for the Air Force.

- During an afterburner takeoff, an F-15C experienced an afterburner blowout and associated FTIT over-temperature. The pilot declared an IFE and landed uneventfully. FOD, consisting of parts of the aircraft 781 forms binder, was found in both engines and in all three wheel-wells. (Class B)
- During routine maintenance being carried out at night, a worker was installing wing pylons using a bomb lift truck, the MHU-83. While moving the vehicle around the front of the aircraft in order to work on the other wing, the pylon adapter on top of the boom struck the radome, causing a two-foot vertical crack in the skin of the radome. (Class C)
- A two-ship of F-15Cs conducted an air combat tactics sortie. As the flight initiated RTB, the weather deteriorated rapidly. The flight split up and flew separate ILS approaches to the home airport. While transitioning to land, one aircraft developed a high sink rate and experienced a hard landing. The aircraft

continued on next page

sustained engine and structural damage. (Class B)

• During a routine maintenance run, a vinyl intake cover was partially ingested into the right engine. The engine sustained internal FOD damage to the fan and compressor core. (Class B)

Anyone can spit out statistics, but how do we prevent them from becoming statistics in the first place? Many smart people have expended tremendous effort in trying to determine how to eliminate, or at least decrease, human cause factors, but I think most people will agree that we will probably never eliminate human error as long as humans are in the equation. Despite this, we stubbornly continue to vie for this lofty goal, knowing that any reduction of human errors is a good thing.

One of the solutions will come as no surprise to anyone, and indeed we harp on it all the time, probably because we fail to do it quite often. I am referring to the importance of knowing and following established rules and procedures. While I acknowledge that specific rules and procedures do not exist for every conceivable scenario, and that there is no substitute for a good dose of common sense, for the most part we operate under fairly clear and unequivocal guidance and regulations. These regulations are largely the result of reaction to previous occurrences. In some cases they are written in the blood of the people who were injured or killed in establishing that rules were required in order to prevent the mishap from happening again. By "cutting corners," you not only cause those sacrifices to have been made in vain, but you probably won't get the task done any quicker anyway.

Any reduction of human errors is a good thing.

Another proven factor in mitigating human error is the importance of being organized. Following established procedures will help you to be organized, but other facets of organization include avoiding distractions, being prepared mentally and physically, and having the necessary tools and expertise available for the task at hand.

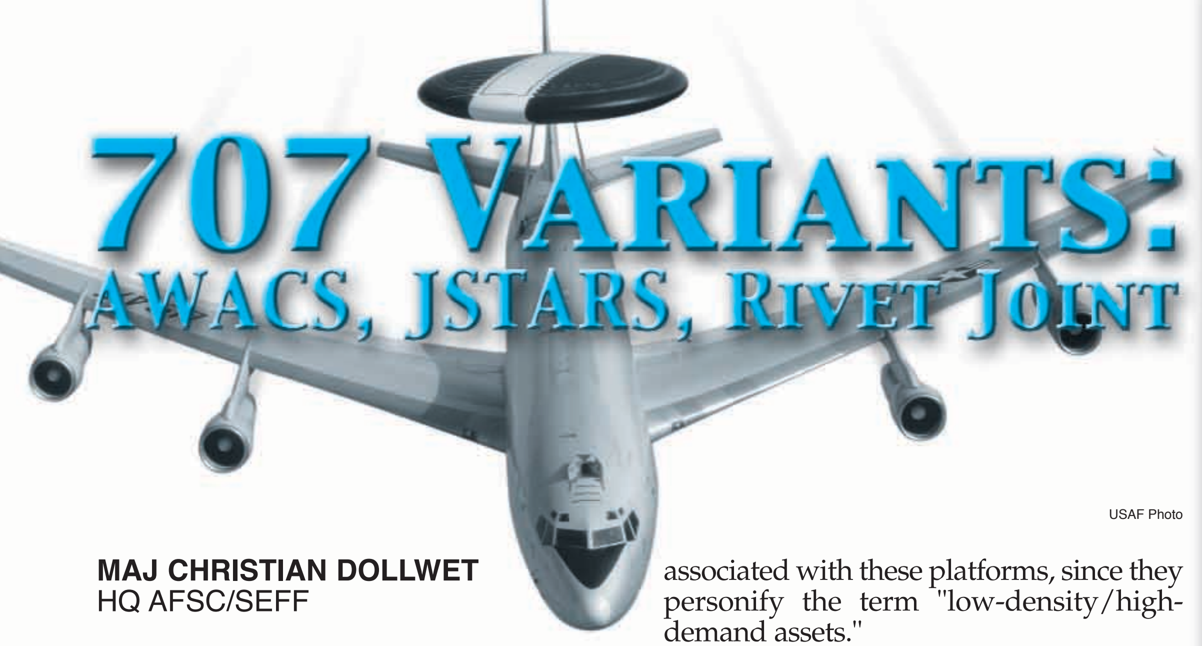
Finally, pay attention when you feel the hair on the back of your neck stand up, or when you get that feeling that you've forgotten something. This "sixth sense" tends to develop with experience, and it can be a real ally, causing you to pause for a moment and reassess a course of action that may result in a mishap.

Recent events have certainly caused us to "lean forward," and the corresponding increase in the tempo of operations will continue to challenge all members of the Air Force team to not only accomplish the mission, but to exercise the vigilance necessary to accomplish it safely. There will no doubt be more emphasis on night flying, which typically tends to be associated with a higher mishap rate. For you flyers, the chances of experiencing Spatial Disorientation and other "SA low" cautions are much greater at night. Night ground ops is more challenging for everyone involved and requires extra care and attention.

The F-15 is an all-weather, day and night fighter, but are you ready to perform your end of the bargain? Especially with winter approaching, is your instrument flying proficiency "up to snuff"? Be honest with yourself and with your supervisors, and ensure that you're fulfilling your instrument flying training requirements. Even when the weather is "clear and a million," plan to fly an approach occasionally, and if you still feel that your skills are lacking, don't be afraid to ask for a dedicated instrument hop to brush up on your skills. If you "shack" your target or "splash" the hostile contact, the price for that success is too high if you can't safely recover the jet under night IMC conditions and be ready to do the same the next day.

There are risks associated with defying gravity on a continual basis. We try to manage those factors that we can influence, and we accept the risks we have no control over. When we "sign on the dotted line," devoting ourselves to serving our country, we are saying that we are willing to sacrifice our lives if necessary. Of course, no one plans to have that happen, and in fact we train constantly with the objective of accomplishing the mission *safely*, since overall success hinges greatly on *sustaining* mission capability.

The stats from FY01 indicate a continuing, exemplary safety record but your challenge is to make it even better. Keep your "craniums up," your wits about you, and I look forward to lauding the achievements of the Eagle community next year.



USAF Photo

707 VARIANTS:
AWACS, JSTARS, RIVET JOINT

MAJ CHRISTIAN DOLLWET
HQ AFSC/SEFF

The E-3 AWACS (Airborne Warning and Control System)—or *Sentry* for you purists out there—the E-8 JSTARS (Joint Surveillance and Target Attack Radar System) and the RC/WC-135 weapon systems each enjoyed another outstanding, safe year, with "Zero" Class A mishaps. To all of you Operators and Maintainers: Well Done!

The E-3 had no Class B mishaps and three Class C mishaps in FY01, and all of those occurred on the ground. The JSTARS had one Class B (engine) mishap—which, as of this writing, may be downgraded to a Class C mishap—and two Class Cs. The Recce-135 family of reconnaissance aircraft (RC/WC) had no Class Bs and only 1 Class C mishap. A closer look at the Class B and C mishaps reveals no operational trends, and this is quite remarkable, considering the number of sorties, flight hours and the fact that many of the sorties took place at deployed locations.

The E-3s logged 2877 sorties (19,535 hours), the JSTARS logged 844 sorties (5574.9 hours) and the Recce-135 reconnaissance aircraft flew 1922 sorties (12,285 hours). That there were no Class A mishaps, a single Class B mishap and so few Class C mishaps, speaks incredibly well of everyone involved in flying and maintaining these airframes. It's obvious that CRM and ORM are being used—and used effectively—both in the air and on the ground.

With Operations ENDURING FREEDOM and NOBLE EAGLE continuing for the foreseeable future, all of America's Armed Forces will be challenged heavily during the coming months. This is especially true for those associated with these platforms, since they personify the term "low-density/high-demand assets."

Fatigue and complacency are the mortal enemies of the Operator and Maintainer, so watch out for yourselves and for each other. I hope to report in the FY02 end-of-year summary that the surveillance/reconnaissance communities once again stood up to the challenge with no loss of life or aircraft. Keep up the safe flight operations!

Here is an "ABC Mishap Category" refresher…

- A Class A mishap is defined as a mishap resulting in one or more of the following:
  - Cost of $1,000,000 or more
  - A fatality or permanent total disability
  - Destruction of an Air Force aircraft
- A Class B mishap is defined as a mishap resulting in one or more of the following:
  - Cost ranging from $200,000 but less than $1,000,000
  - A permanent partial disability
  - Inpatient hospitalization of three or more personnel
- A Class C mishap is defined as a mishap resulting in one or more of the following:
  - Reportable damage between $20,000 and $200,000
  - An injury resulting in a lost workday case involving 8 hours or more away from work beyond the day or shift on which it occurred; or an occupational illness that causes loss of time from work at any time ✈

It's obvious that CRM and ORM are being used—and used effectively.

The Bombers: B-1, B-2 and B-52

MAJOR DAN "RCR" BAKER
AFSC/SEFF

What happened in the bomber world last year, what's going on now and what does the future hold? The big safety news for the bomber force was there were no flight-related Class A mishaps again this year, and there were no significant trends in any of the weapons systems. Human Factors were present, as well as material failures and acts of nature.

Although the overall FY01 Air Force safety record did not meet the low numbers of last year in terms of Class A rates, the bomber force has remained stable, even showing improvement in some airframes. This has left us with a very viable and effective combat force today. Considering the attack on America on 11 September, this is a very good thing.

All three of our bombers are engaged in combat operations as I write this article.

USAF Photo

All three of our bombers are engaged in combat operations as I write this article. It is obvious we need to continue to preserve these resources to maintain our awesome combat capabilities, and safety is definitely an ally in our cause.

B-52

Will the old BUFF ever die? I seriously doubt it. This weapons platform will continue to change its mission and tactics to meet future challenges well into this new century. Even now, the B-52 is participating in yet another conflict and adding to its list of impressive accomplishments. This airframe has maintained a fairly consistent safety record for the past several years.

As I looked at the mishaps for the BUFF from this past year, it became apparent the engines on this airframe accounted for the majority of the mishaps (93 percent—all but one mishap). I suppose with eight engines the odds of having an engine mishap do increase exponentially. These engine mishaps were made up mostly of unrelated FOD incidents, with a couple of oil problems thrown in for extra measure. With blade failures, a seized engine or two, a couple of forgotten rivets and a bird strike, the engines took it from several different directions. There was even a reportable ground mishap where a ladder attacked the leading edge of an engine cowling (with the help of an unsuspecting human, of course!).

While most of these mishaps did not involve human error, there is still room for improvement on our part.

B-1

The mighty "Bone" is at it again, making history in combat, as well as establishing new safety milestones. Not only has the B-1 been attacking those who attacked the U.S., but it has been breaking its own safety record, too. The number of reportable flight mishaps declined from 28 in FY00 to only 8 for FY01. The cost difference? Over $3.3 million! Those mishaps that did occur didn't indicate any trends or areas of concern.

Bone mishaps ranged from hot brakes to electrical fires to engine FOD and birdstrikes. No single thing could be identified as the sole reason for the decrease from FY00. On the down side there was a ground engine fire involving aircrew that resulted in Class A damage. There was also an interesting HAP reported when an aircrew inadvertently deployed the slats while flying in the low-altitude regime. The resulting changes in the aircraft aerodynamics and flight control system resulted in severe pitch oscillations—severe enough for the crew to consider ejection. An interesting ground mishap occurred when a fuel system malfunction caused an unattended aircraft to tip back and rest on its tail.

B-2

The B-2 continues to have a stellar safety record as it performs remarkably in combat. FY01 mimicked FY00's record of a single Class C mishap. A single engine problem resulted in over $100K in damage. The B-2 safety record is pretty incredible when you realize the aircrews and aircraft are flying record-setting combat sorties over 40 hours in duration. These types of sorties are definitely pushing both aircrew and aircraft to the limits, requiring the utmost in caution.

As I have alluded to throughout this article, and as all of you are aware, America is fighting a new war. While you are reading this, many of our brethren are probably engaged in combat operations somewhere in the world, if not over our own skies. The role of our bombers and aircrew in this endeavor is not a small one. All three weapon systems were proven in combat before this conflict began, but as we progress there will be new weapons, new tactics and even new crewmembers brought into this war. This is nothing new to the way the Air Force has done business throughout its history.

So what does all this rambling have to do with flight safety, you ask? It is imperative we continue to apply proven ORM and safety practices to all we do. Don't be afraid to step forward when something doesn't look or sound right. Remember the basics: Make sure you know your technical orders and regulations, as well as your tactics. If everyone continues to do business the way we have for the last year, our next year will be just as good, if not better.

A fuel system malfunction caused an unattended aircraft to tip back and rest on its tail.

FY01 Mishap Stats

Welcome once again to the annual "Aircraft Statistics" pages. Just like last year, you'll note that we're only showing stats for the most recent 10 years (if applicable) of each aircraft. These stats are for "Flight Mishaps" only, and don't include any from "Flight-Related," "Ground" or other mishap categories.

Before proceeding, a couple of notes. First, this data is correct as of this printing. However, ongoing investigations may result in a mishap being upgraded or downgraded at a later date. If so, corrections will appear in next year's annual round-up. Second, you'll see a single asterisk appear here and there throughout the aircraft stats in the far left-hand column. When you see an asterisk, it indicates that there is a correction—flying hours and/or data—from last year's stats. For our readers who carefully review these annual statistics, you need only compare this year's asterisked data to the same lines from last year's pages to see what was changed. Finally, please note that since tallies haven't been finalized, flying hours for FY00 for all aircraft are estimated for Jul-Sep 01.

Those interested in earlier numbers may view them at the AFSC web page at: http://safety.kirtland.af.mil/AFSC/RDBMS/Flight/stats/statspage.html (".mil" and ".gov" users only).

A-10

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	FATAL ALL	HOURS	CUM HRS
FY92	3	1.79	0	0.00	3	1.79	1	1	167,648	2,809,416
*FY93	2	1.74	0	0.00	2	1.74	1	1	115,064	2,924,480
FY94	4	3.35	0	0.00	5	4.19	1	1	119,329	3,043,809
FY95	2	1.69	1	0.84	2	1.69	1	1	118,602	3,162,411
FY96	2	1.63	0	0.00	2	1.63	1	1	122,953	3,285,364
FY97	3	2.40	1	0.80	3	2.40	2	2	125,100	3,410,464
FY98	1	0.81	0	0.00	1	0.81	0	0	124,119	3,534,583
FY99	2	1.63	3	2.45	1	0.82	0	0	122,629	3,657,212
*FY00	2	1.80	13	11.70	1	0.90	1	1	111,111	3,768,323
FY01	2	1.78	4	3.57	2	1.78	0	0	112,088	3,880,411
LIFETIME CY72-FY01	94	2.42	66	1.70	94	2.42	47	54	3,880,411	
5 YR AVG	2.0	1.68	4.2	3.53	1.6	1.34	0.6	0.6	119,009.4	
10 YR AVG	2.3	1.86	2.2	1.78	2.2	1.78	0.8	0.8	123,846.3	

U-2

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	FATAL ALL	HOURS	CUM HRS
FY92	1	6.03	0	0.00	1	6.03	1	1	16,597	274,024
FY93	0	0.00	0	0.00	0	0.00	0	0	18,085	292,109
FY94	2	12.79	0	0.00	2	12.79	1	1	15,643	307,752
FY95	1	5.64	0	0.00	1	5.64	1	1	17,726	325,478
FY96	2	12.11	0	0.00	1	6.05	1	2	16,518	341,996
FY97	1	8.62	0	0.00	0	0.00	0	0	11,601	353,597
FY98	0	0.00	0	0.00	0	0.00	0	0	11,431	365,028
FY99	2	17.49	0	0.00	0	0.00	0	0	11,436	376,464
FY00	0	0.00	0	0.00	0	0.00	0	0	11,435	387,899
FY01	0	0.00	0	0.00	0	0.00	0	0	7,715	395,614
LIFETIME CY63-FY01	27	6.82	1	0.25	20	5.06	7	12	395,614	
5 YR AVG	0.6	5.60	0	0.00	0.2	1.60	0.2	0.4	10,724	
10 YR AVG	0.9	6.51	0	0.00	0.5	3.62	0.4	0.5	13,819	

B-1

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	FATAL ALL	HOURS	CUM HRS
FY92	3	11.12	0	0.00	0	0.00	0	0	26,970	134,604
FY93	1	3.31	1	3.31	1	3.31	2	4	30,179	164,783
FY94	0	0.00	1	3.40	0	0.00	0	0	29,383	194,166
FY95	0	0.00	3	10.80	0	0.00	0	0	27,781	221,947
FY96	0	0.00	1	3.79	0	0.00	0	0	26,371	248,318
FY97	1	4.03	3	12.10	1	4.03	2	4	24,803	273,121
FY98	1	4.21	2	8.42	1	4.21	0	0	23,744	296,865
FY99	0	0.00	1	4.37	0	0.00	0	0	22,884	319,749
*FY00	0	0.00	6	24.29	0	0.00	0	0	24,703	344,452
FY01	0	0.00	2	8.43	0	0.00	0	0	23,725	368,177
LIFETIME CY84-FY01	12	3.26	26	7.06	6	1.63	6	11	368,177	
5YR AVG	0.4	1.67	2.8	11.68	0.4	1.67	0.4	0.8	22,972	
10 YR AVG	0.6	2.30	2.0	7.68	0.3	1.15	0.4	0.8	26,054	

B-2

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	FATAL ALL	HOURS	CUM HRS
FY92	0	0.00	0	0.00	0	0.00	0	0	0,378	0,663
FY93	0	0.00	0	0.00	0	0.00	0	0	0,455	1,118
FY94	0	0.00	0	0.00	0	0.00	0	0	0,976	2,094
FY95	0	0.00	0	0.00	0	0.00	0	0	2,415	4,509
FY96	0	0.00	0	0.00	0	0.00	0	0	3,248	7,757
FY97	0	0.00	0	0.00	0	0.00	0	0	3,743	11,491
FY98	0	0.00	0	0.00	0	0.00	0	0	3,078	14,569
FY99	0	0.00	1	21.74	0	0.00	0	0	4,600	19,169
*FY00	0	0.00	0	0.00	0	0.00	0	0	5,446	24,615
FY01	0	0.00	0	0.00	0	0.00	0	0	5,694	30,249
LIFETIME FY90-FY01	0	0.00	1	3.30	0	0.00	0	0	30,249	
5 YR AVG	0	0.00	0	4.43	0	0.00	0	0	4,510	
10 YR AVG	0	0.00	0	3.33	0	0.00	0	0	3,002	

B-52

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	FATAL ALL	HOURS	CUM HRS
FY92	0	0.00	0	0.00	0	0.00	0	0	69,056	7,288,653
FY93	0	0.00	1	1.88	0	0.00	0	0	53,293	7,341,946
FY94	1	3.11	1	3.11	1	3.11	4	0	32,146	7,374,092
FY95	1	4.13	1	4.13	0	0.00	0	0	24,223	7,398,315
FY96	0	0.00	0	0.00	0	0.00	0	0	25,506	7,423,821
*FY97	0	0.00	0	0.00	0	0.00	0	0	23,297	7,447,118
FY98	0	0.00	0	0.00	0	0.00	0	0	22,852	7,469,970
FY99	0	0.00	0	0.00	0	0.00	0	0	21,643	7,491,613
*FY00	0	0.00	6	27.84	0	0.00	0	0	21,554	7,513,167
FY01	0	0.00	6	30.11	0	0.00	0	0	19,929	7,533,096
LIFETIME CY55-FY01	97	1.29	176	2.34	76	1.01	100	311	7,533,096	
5 YR AVG	0	0.00	2.4	10.98	0	0.00	0	0	21,855	
10 YR AVG	0.2	0.64	1.5	4.78	0.1	0.32	0.4	0	31,350	

C-5

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	FATAL ALL	HOURS	CUM HRS
FY92	0	0.00	1	1.51	0	0.00	0	0	66,324	1,310,984
FY93	0	0.00	2	2.55	0	0.00	0	0	78,319	1,389,303
FY94	0	0.00	4	5.49	0	0.00	0	0	72,899	1,462,202
FY95	0	0.00	1	1.55	0	0.00	0	0	64,608	1,526,810
FY96	0	0.00	0	0.00	0	0.00	0	0	67,499	1,594,309
FY97	0	0.00	1	1.58	0	0.00	0	0	63,120	1,657,429
FY98	0	0.00	0	0.00	0	0.00	0	0	64,506	1,721,935
FY99	0	0.00	0	0.00	0	0.00	0	0	56,988	1,778,923
*FY00	0	0.00	2	3.78	0	0.00	0	0	52,872	1,831,795
FY01	1	1.78	1	1.78	0	0.00	0	0	56,078	1,887,873
LIFETIME CY68-FY01	16	0.85	40	2.12	4	0.21	5	168	1,887,873	
5 YR AVG	0.2	0.34	0.8	1.36	0	0.00	0	0	58,713	
10 YR AVG	0.1	0.16	1.2	1.87	0	0.00	0	0	64,321	

C-9

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	FATAL ALL	HOURS	CUM HRS
FY92	0	0.00	0	0.00	0	0.00	0	0	27,260	644,850
FY93	0	0.00	0	0.00	0	0.00	0	0	26,072	670,922
FY94	0	0.00	0	0.00	0	0.00	0	0	25,087	696,009
FY95	0	0.00	1	3.83	0	0.00	0	0	26,119	722,128
FY96	0	0.00	0	0.00	0	0.00	0	0	24,602	746,730
FY97	0	0.00	0	0.00	0	0.00	0	0	23,260	769,990
FY98	0	0.00	0	0.00	0	0.00	0	0	21,361	791,351
FY99	1	4.95	0	0.00	0	0.00	0	0	20,205	811,556
*FY00	0	0.00	0	0.00	0	0.00	0	0	19,868	831,424
FY01	0	0.00	0	0.00	0	0.00	0	0	21,072	852,496
LIFETIME CY68-FY01	3	0.35	2	0.23	1	0.12	3	3	852,496	
5 YR AVG	0.2	0.95	0	0.00	0	0.00	0	0	21,153	
10 YR AVG	0.1	0.43	0.1	0.43	0	0.00	0	0	23,491	

KC-10

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	FATAL ALL	HOURS	CUM HRS
FY92	1	2.31	1	2.31	0	0.00	0	0	43,253	382,897
FY93	0	0.00	0	0.00	0	0.00	0	0	54,266	437,163
FY94	0	0.00	0	0.00	0	0.00	0	0	52,289	489,452
FY95	0	0.00	0	0.00	0	0.00	0	0	43,381	532,833
FY96	2	3.87	0	0.00	0	0.00	0	0	51,725	584,558
FY97	0	0.00	0	0.00	0	0.00	0	0	50,181	634,739
FY98	0	0.00	0	0.00	0	0.00	0	0	48,809	683,548
*FY99	0	0.00	1	1.88	0	0.00	0	0	53,286	736,834
*FY00	1	2.05	0	0.00	0	0.00	0	0	48,746	785,580
FY01	1	2.29	5	11.45	0	0.00	0	0	43,669	829,249
LIFETIME CY81-FY01	6	0.72	11	1.33	0	0.00	0	0	829,249	
5 YR AVG	0.4	0.82	1.2	2.45	0	0.00	0	0	48,938.2	
10 YR AVG	0.5	1.02	0.7	1.43	0	0.00	0	0	48,960.5	

C-12

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	FATAL ALL	HOURS	CUM HRS
FY92	0	0.00	0	0.00	0	0.00	0	0	28,893	308,595
FY93	0	0.00	0	0.00	0	0.00	0	0	27,099	335,694
FY94	0	0.00	0	0.00	0	0.00	0	0	16,500	352,194
FY95	0	0.00	0	0.00	0	0.00	0	0	21,461	373,655
FY96	0	0.00	0	0.00	0	0.00	0	0	4,740	378,395
FY97	0	0.00	0	0.00	0	0.00	0	0	4,728	383,123
FY98	0	0.00	0	0.00	0	0.00	0	0	5,666	388,789
FY99	0	0.00	0	0.00	0	0.00	0	0	4,416	393,205
*FY00	0	0.00	0	0.00	0	0.00	0	0	3,689	396,894
FY01	0	0.00	0	0.00	0	0.00	0	0	4,459	401,353
LIFETIME CY75-FY01	2	0.50	1	0.25	1	0.25	2	6	401,353	
5 YR AVG	0	0.00	0	0.00	0	0.00	0	0	4,592	
10 YR AVG	0	0.00	0	0.00	0	0.00	0	0	12,165	

C-17

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	FATAL ALL	HOURS	CUM HRS
FY92	0	0.00	0	0.00	0	0.00	0	0	,539	,547
FY93	0	0.00	0	0.00	0	0.00	0	0	1,252	1,799
FY94	0	0.00	0	0.00	0	0.00	0	0	4,454	6,253
FY95	0	0.00	0	0.00	0	0.00	0	0	12,968	19,221
FY96	1	4.75	1	4.75	0	0.00	0	0	21,050	40,271
FY97	1	3.78	1	3.78	0	0.00	0	0	26,486	66,757
FY98	1	2.35	0	0.00	0	0.00	0	0	42,623	109,380
FY99	0	0.00	0	0.00	0	0.00	0	0	56,676	166,056
*FY00	0	0.00	3	5.13	0	0.00	0	0	58,423	224,480
FY01	0	0.00	3	3.60	0	0.00	0	0	83,395	307,875
LIFETIME FY91-FY01	3	0.97	8	2.60	0	0.00	0	0	307,875	
5 YR AVG	0.4	0.75	1.4	2.62	0	0.00	0	0	53,521	
10 YR AVG	0.3	0.97	0.8	2.60	0	0.00	0	0	30,787	

C-20

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	FATAL ALL	HOURS	CUM HRS
FY92	0	0.00	0	0.00	0	0.00	0	0	6,994	52,849
FY93	0	0.00	0	0.00	0	0.00	0	0	6,046	58,895
FY94	0	0.00	0	0.00	0	0.00	0	0	6,617	65,512
*FY95	0	0.00	0	0.00	0	0.00	0	0	6,469	71,981
*FY96	0	0.00	0	0.00	0	0.00	0	0	6,651	78,632
*FY97	0	0.00	0	0.00	0	0.00	0	0	6,335	84,967
*FY98	0	0.00	0	0.00	0	0.00	0	0	6,817	91,784
*FY99	0	0.00	0	0.00	0	0.00	0	0	6,757	98,541
*FY00	0	0.00	1	18.05	0	0.00	0	0	5,539	104,080
FY01	0	0.00	0	0.00	0	0.00	0	0	6,874	110,954
LIFETIME CY83-FY01	0	0.00	1	0.90	0	0.00	0	0	110,954	
5 YR AVG	0	0.00	0.2	3.09	0	0.00	0	0	6,464	
10 YR AVG	0	0.00	0.1	1.54	0	0.00	0	0	6,510	

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	FATAL ALL	HOURS	CUM HRS
FY92	0	0.00	0	0.00	0	0.00	0	0	47,603	424,056
FY93	0	0.00	0	0.00	0	0.00	0	0	48,421	472,477
FY94	0	0.00	0	0.00	0	0.00	0	0	47,336	519,813
FY95	1	2.13	0	0.00	1	2.13	2	7	47,020	566,833
FY96	0	0.00	0	0.00	0	0.00	0	0	46,239	613,072
*FY97	0	0.00	0	0.00	0	0.00	0	0	46,743	659,815
FY98	0	0.00	0	0.00	0	0.00	0	0	45,231	705,046
FY99	0	0.00	1	2.16	0	0.00	0	0	46,234	751,280
*FY00	0	0.00	0	0.00	0	0.00	0	0	46,485	797,765
FY01	0	0.00	0	0.00	0	0.00	0	0	47,111	844,876
LIFETIME CY84-FY01	2	0.24	1	0.00	2	0.24	4	9	844,876	
5 YR AVG	0	0.00	0.2	0.43	0	0.00	0	0	46,361	
10 YR AVG	0.1	0.21	0.1	0.21	0.1	0.21	0.2	0.7	46,842	

C-21

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	FATAL ALL	HOURS	CUM HRS
FY92	2	0.63	0	0.00	2	0.63	8	24	315,952	12,969,733
FY93	1	0.33	0	0.00	1	0.33	2	6	300,157	13,269,890
*FY94	1	0.36	1	0.36	1	0.36	0	8	279,923	13,549,813
FY95	1	0.35	1	0.35	1	0.35	2	6	282,864	13,832,677
FY96	1	0.34	1	0.34	1	0.34	2	9	294,075	14,126,752
*FY97	2	0.70	1	0.35	2	0.70	2	13	283,997	14,410,749
FY98	0	0.00	0	0.00	0	0.00	0	0	282,876	14,693,625
FY99	0	0.00	0	0.00	0	0.00	0	0	283,542	14,977,167
*FY00	1	0.37	12	4.42	0	0.00	0	3	271,724	15,248,891
FY01	2	0.71	10	3.57	0	0.00	0	0	279,843	15,528,734
LIFETIME CY55-FY01	145	0.93	164	1.06	83	0.53	134	616	15,528,734	
5 YR AVG	1.0	0.36	4.6	1.64	0.4	0.14	0.4	3.2	280,396	
10 YR AVG	1.1	0.38	2.6	0.90	0.8	0.28	1.6	6.9	287,495	

C-130

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	FATAL ALL	HOURS	CUM HRS
FY92	1	0.39	0	0.00	1	0.39	0	0	255,073	10,225,044
FY93	0	0.00	1	0.41	0	0.00	0	0	245,711	10,470,755
FY94	0	0.00	0	0.00	0	0.00	0	0	219,206	10,689,961
FY95	0	0.00	1	0.45	0	0.00	0	0	219,880	10,909,841
FY96	0	0.00	1	0.46	0	0.00	0	0	215,105	11,124,946
FY97	0	0.00	3	1.41	0	0.00	0	0	212,055	11,337,001
FY98	1	0.47	0	0.00	0	0.00	0	0	211,206	11,548,207
FY99	1	0.48	1	0.48	1	0.48	2	4	207,796	11,756,003
*FY00	0	0.00	1	0.56	0	0.00	0	0	177,394	11,933,397
FY01	0	0.00	5	2.66	0	0.00	0	0	188,067	12,121,464
LIFETIME CY57-FY01	79	0.65	127	1.05	64	0.53	134	629	12,121,464	
5 YR AVG	0.4	0.20	2.0	1.00	0.2	0.10	0.4	0.8	199,304	
10 YR AVG	0.3	0.14	1.3	0.60	0.2	0.09	0.2	0.4	215,149	

C-135

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	ALL	HOURS	CUM HRS
FY92	0	0.00	0	0.00	0	0.00	0	0	226,312	9,446,974
FY93	1	0.49	0	0.00	2	0.98	4	13	203,264	9,650,238
FY94	0	0.00	0	0.00	1	0.78	0	0	127,938	9,778,176
FY95	0	0.00	0	0.00	0	0.00	0	0	157,059	9,935,235
FY96	0	0.00	0	0.00	0	0.00	0	0	146,417	10,081,652
FY97	1	0.83	1	0.83	1	0.83	2	9	121,043	10,202,695
FY98	1	0.97	0	0.00	0	0.00	0	0	102,917	10,305,612
FY99	0	0.00	1	1.13	0	0.00	0	0	88,888	10,394,500
*FY00	0	0.00	5	7.74	0	0.00	0	0	64,581	10,459,081
FY01	0	0.00	4	7.00	0	0.00	0	0	57,155	10,516,236
LIFETIME CY64-FY01	34	0.32	39	0.37	16	0.15	34	161	10,516,236	
5 YR AVG	0.4	0.46	2.2	2.53	0.2	0.23	0.4	1.8	ß86,916.8	
10 YR AVG	0.3	0.23	1.1	0.85	0.4	0.31	0.6	2.2	129,557.4	

C-141

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	ALL	HOURS	CUM HRS
FY92	0	0.00	0	0.00	0	0.00	0	0	33,329	368,727
FY93	0	0.00	0	0.00	0	0.00	0	0	27,782	396,509
FY94	0	0.00	0	0.00	0	0.00	0	0	24,381	420,890
FY95	1	3.90	0	0.00	1	3.90	2	22	25,612	446,502
FY96	0	0.00	0	0.00	0	0.00	0	0	25,430	471,932
FY97	0	0.00	0	0.00	0	0.00	0	0	21,752	493,684
FY98	0	0.00	0	0.00	0	0.00	0	0	20,960	514,644
FY99	0	0.00	1	5.06	0	0.00	0	0	19,762	534,406
FY00	0	0.00	0	0.00	0	0.00	0	0	19,665	554,071
FY01	0	0.00	1	4.56	0	0.00	0	0	21,950	576,021
LIFETIME CY77-FY01	1	0.17	4	0.69	1	0.17	2	22	576,021	
5YR AVG	0	0.00	0.4	1.92	0	0.00	0	0	20,818	
10 YR AVG	0.1	0.42	0.2	0.83	0.1	0.42	0.2	2.2	24,062	

E-3

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	ALL	HOURS	CUM HRS
FY92	0	0.00	1	58.28	0	0.00	0	0	1,716	31,533
FY93	0	0.00	1	74.96	0	0.00	0	0	1,334	32,867
FY94	0	0.00	0	0.00	0	0.00	0	0	1,587	34,454
FY95	0	0.00	0	0.00	0	0.00	0	0	1,697	36,151
FY96	0	0.00	0	0.00	0	0.00	0	0	1,401	37,552
FY97	0	0.00	0	0.00	0	0.00	0	0	1,310	38,862
*FY98	0	0.00	0	0.00	0	0.00	0	0	1,363	40,225
*FY99	0	0.00	1	78.74	0	0.00	0	0	1,270	41,495
*FY00	0	0.00	0	0.00	0	0.00	0	0	1,373	42,868
FY01	0	0.00	1	61.27	0	0.00	0	0	1,632	44,500
LIFETIME CY75-FY01	1	2.25	4	8.99	0	0.00	0	0	44,500	
5 YR AVG	0	0.00	0.4	28.79	0	0.00	0	0	1,389.6	
10 YR AVG	0	0.00	0.4	27.24	0	0.00	0	0	1,468.3	

E-4

E-8

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	FATAL ALL	HOURS	CUM HRS
FY92	0	0.00	0	0.00	0	0.00	0	0	0,514	0,623
FY93	0	0.00	0	0.00	0	0.00	0	0	1,219	1,842
FY94	0	0.00	0	0.00	0	0.00	0	0	0,524	2,366
FY95	0	0.00	0	0.00	0	0.00	0	0	0,361	2,727
FY96	0	0.00	0	0.00	0	0.00	0	0	0,724	3,451
FY97	0	0.00	0	0.00	0	0.00	0	0	1,305	4,756
FY98	0	0.00	0	0.00	0	0.00	0	0	2,106	6,862
FY99	0	0.00	0	0.00	0	0.00	0	0	3,327	10,189
*FY00	1	23.99	1	23.99	0	0.00	0	0	4,169	14,358
FY01	0	0.00	1	14.28	0	0.00	0	0	7,004	21,362
LIFETIME FY91-FY01	1	4.68	2	9.36	0	0.00	0	0	21,362	
5 YR AVG	0.2	5.58	0.4	11.17	0	0.00	0	0	3,582	
10 YR AVG	0.1	4.71	0.2	9.41	0	0.00	0	0	2,125	

F-15

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	FATAL ALL	HOURS	CUM HRS
FY92	5	2.26	2	0.91	5	2.26	2	3	220,866	2,652,385
FY93	3	1.38	5	2.30	3	1.38	0	0	217,547	2,869,932
FY94	4	1.90	3	1.43	4	1.90	1	1	210,241	3,080,173
*FY95	4	1.94	5	2.42	3	1.45	1	2	206,649	3,286,822
FY96	4	1.99	2	1.00	3	1.49	0	0	200,766	3,487,588
FY97	3	1.56	5	2.60	2	1.04	0	0	192,081	3,679,669
FY98	3	1.59	5	2.66	2	1.06	0	0	188,204	3,867,873
FY99	7	3.70	9	4.76	6	3.17	1	2	189,109	4,056,982
*FY00	3	1.67	21	11.71	1	0.56	0	0	179,372	4,236,329
FY01	2	1.12	20	11.16	2	1.12	2	2	179,133	4,415,487
LIFETIME CY72-FY01	109	2.47	195	4.42	100	2.26	37	44	4,415,487	
5 YR AVG	3.6	1.94	12.0	6.47	2.6	1.40	0.6	0.8	185,579.8	
10 YR AVG	3.8	1.92	7.7	3.88	3.1	1.56	0.7	1.0	198,396.8	

F-16

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	FATAL ALL	HOURS	CUM HRS
FY92	18	4.04	1	0.22	18	4.04	7	8	445,201	3,295,922
FY93	18	4.15	2	0.46	18	4.15	4	5	433,960	3,729,882
*FY94	16	4.00	2	0.50	15	3.75	3	27	400,474	4,130,356
*FY95	9	2.33	2	0.26	9	2.33	1	1	386,429	4,516,785
*FY96	8	2.14	5	1.34	7	1.87	0	1	374,517	4,891,302
*FY97	11	3.06	0	0.00	11	3.06	1	1	360,038	5,251,340
*FY98	14	3.89	1	0.28	12	3.33	5	6	360,245	5,611,585
*FY99	18	5.11	3	0.85	16	4.54	2	2	352,275	5,963,860
*FY00	9	2.62	8	2.33	9	2.62	2	2	343,085	6,306,945
FY01	13	3.83	9	2.65	13	3.83	4	6	339,553	6,646,498
LIFETIME CY75-FY01	286	4.30	52	0.78	272	4.09	73	110	6,646,498	
5 YR AVG	13.0	3.70	4.2	1.20	12.2	3.48	2.8	3.4	351,039.2	
10 YR AVG	13.4	3.53	3.2	0.84	12.8	3.37	2.9	5.9	379,577.7	

F-117

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	ALL	HOURS	CUM HRS
FY92	1	8.71	0	0.00	1	8.71	0	0	11,481	29,356
FY93	0	0.00	2	15.95	0	0.00	0	0	12,538	41,894
FY94	0	0.00	0	0.00	0	0.00	0	0	12,136	54,030
FY95	2	15.62	0	0.00	1	7.81	1	1	12,804	66,834
FY96	0	0.00	1	7.59	0	0.00	0	0	13,171	80,005
FY97	3	23.69	0	0.00	1	7.90	0	0	12,661	92,666
FY98	0	0.00	0	0.00	0	0.00	0	0	12,470	105,136
FY99	1	7.35	1	7.35	0	0.00	0	0	13,599	118,735
*FY00	0	0.00	0	0.00	0	0.00	0	0	13,585	132,320
FY01	0	0.00	1	7.79	0	0.00	0	0	12,833	145,153
LIFETIME FY91-FY01	7	4.82	5	3.44	3	2.07	1	1	145,153	
5 YR AVG	0.8	6.14	0.4	3.07	0.0	0.00	0.0	0.0	13,029.6	
10 YR AVG	0.7	5.50	0.5	3.93	0.3	2.36	0.1	0.1	12,727.8	

H-1

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	ALL	HOURS	CUM HRS
*FY92	2	7.21	0	0.00	2	7.21	3	7	27,729	1,395,839
*FY93	0	0.00	0	0.00	0	0.00	0	0	25,945	1,421,784
*FY94	1	4.15	1	4.15	1	4.15	0	0	24,099	1,445,883
*FY95	1	4.60	0	0.00	1	4.60	0	0	21,761	1,467,644
*FY96	1	4.73	0	0.00	1	4.73	0	0	21,141	1,488,785
*FY97	0	0.00	0	0.00	0	0.00	0	0	20,716	1,509,501
*FY98	1	5.05	0	0.00	1	5.05	0	0	19,787	1,529,288
*FY99	0	0.00	0	0.00	0	0.00	0	0	19,354	1,548,642
*FY00	1	5.26	0	0.00	1	5.26	0	0	19,005	1,567,647
FY01	0	0.00	0	0.00	0	0.00	0	0	18,934	1,586,581
LIFETIME CY71-FY01	53	3.34	14	0.88	25	1.58	15	41	1,586,581	
5 YR AVG	0.4	2.05	0	0.00	0.4	2.05	0	0	19,559.2	
10 YR AVG	0.7	3.20	0.1	0.46	0.7	3.20	0.3	0.7	21,847.1	

H-53

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	ALL	HOURS	CUM HRS
FY92	0	0.00	0	0.00	0	0.00	0	0	12,238	339,019
FY93	0	0.00	0	0.00	0	0.00	0	0	12,019	351,038
FY94	0	0.00	0	0.00	0	0.00	0	0	12,106	363,144
FY95	1	8.43	0	0.00	1	8.43	0	0	11,857	375,001
FY96	1	7.44	0	0.00	0	0.00	0	0	13,436	388,415
FY97	0	0.00	0	0.00	0	0.00	0	0	12,996	401,433
FY98	0	0.00	0	0.00	0	0.00	0	0	13,926	415,359
FY99	1	7.36	1	7.36	1	7.36	0	1	13,578	428,937
*FY00	1	7.00	1	7.00	0	0.00	0	0	14,293	443,230
FY01	0	0.00	2	16.69	0	0.00	0	0	11,980	455,210
LIFETIME CY66-FY01	28	6.15	19	4.17	20	4.39	24	81	455,210	
5 YR AVG	0.4	3.00	0.8	5.99	0.2	1.50	0	0.2	13,355	
10 YR AVG	0.4	3.11	0.4	3.11	0.2	1.56	0	0.1	12,843	

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	FATAL ALL	HOURS	CUM HRS
FY92	1	5.15	0	0.00	1	5.15	0	1	19,401	68,240
FY93	1	4.37	0	0.00	1	4.37	1	12	22,871	91,111
FY94	2	8.25	1	4.13	1	4.13	0	0	24,229	115,340
FY95	1	3.75	1	3.75	1	3.75	2	5	26,666	142,006
FY96	0	0.00	0	0.00	0	0.00	0	0	27,809	169,815
*FY97	0	0.00	0	0.00	0	0.00	0	0	26,004	195,819
*FY98	1	3.84	0	0.00	2	7.69	4	12	26,014	221,833
*FY99	0	0.00	0	0.00	0	0.00	0	0	26,383	248,216
*FY00	1	3.90	0	0.00	0	0.00	0	0	25,649	273,865
FY01	0	0.00	0	0.00	0	0.00	0	0	27,320	301,185
LIFETIME CY82-FY01	9	2.99	2	0.66	7	2.32	9	34	301,185	
5 YR AVG	0.4	1.52	0	0.00	0.4	1.52	0.8	2.4	26,274.0	
10 YR AVG	0.7	2.77	0.2	0.79	0.6	2.38	0.7	3.0	25,234.6	

H-60

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	FATAL ALL	HOURS	CUM HRS
FY92	0	0.00	0	0.00	0	0.00	0	0	0,001	0,001
FY93	0	0.00	0	0.00	0	0.00	0	0	18,063	18,064
FY94	0	0.00	0	0.00	0	0.00	0	0	32,304	50,368
FY95	0	0.00	0	0.00	0	0.00	0	0	41,055	91,423
FY96	0	0.00	0	0.00	0	0.00	0	0	48,186	139,609
FY97	0	0.00	0	0.00	0	0.00	0	0	58,420	198,029
FY98	0	0.00	0	0.00	0	0.00	0	0	78,618	276,647
*FY99	0	0.00	1	1.01	0	0.00	0	0	98,994	375,641
*FY00	0	0.00	2	1.95	0	0.00	0	0	102,376	478,017
FY01	0	0.00	2	2.11	0	0.00	0	0	94,634	572,651
LIFETIME FY92-FY01	0	0.00	5	0.87	0	0.00	0	0	572,651	
5 YR AVG	0	0.00	1.0	1.15	0	0.00	0	0	86,608	
10 YR AVG	0.0	0.00	0.5	0.87	0.0	0.00	0.0	0.0	57,265	

T-1

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	FATAL ALL	HOURS	CUM HRS
*FY00	1	114.94	0	0.00	1	114.94	0	0	0,870	0,870
FY01	0	0.0	0	0.00	1	6.57	0	0	15,217	16,087
LIFETIME FY00-FY01	1	6.22	0	0.00	2	12.43	0	0	16,087	

T-6

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	ALL	HOURS	CUM HRS
FY92	2	0.85	0	0.00	3	1.28	2	2	234,830	11,164,812
FY93	1	0.56	0	0.00	1	0.56	0	0	179,933	11,344,745
FY94	0	0.00	0	0.00	0	0.00	0	0	151,651	11,496,396
FY95	1	0.74	0	0.00	1	0.74	0	0	134,425	11,630,821
FY96	0	0.00	0	0.00	0	0.00	0	0	144,079	11,774,230
FY97	1	0.63	0	0.00	1	0.63	0	0	159,855	11,934,755
FY98	0	0.00	0	0.00	0	0.00	0	0	183,911	12,118,666
FY99	0	0.00	0	0.00	0	0.00	0	0	201,993	12,320,659
*FY00	1	0.49	0	0.00	1	0.49	0	1	202,950	12,523,609
FY01	1	0.57	0	0.00	1	0.57	0	0	175,569	12,699,178
LIFETIME CY56-FY01	135	1.06	31	0.24	133	1.05	26	76	12,699,178	
5 YR AVG	0.6	0.32	0	0.00	0.6	0.32	0	0.2	184,856	
10 YR AVG	0.7	0.40	0	0.00	0.8	0.45	0.2	0.3	176,920	

T-37

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	ALL	HOURS	CUM HRS
FY92	1	0.38	0	0.00	0	0.00	1	1	265,369	11,218,712
FY93	3	1.33	0	0.00	3	1.33	0	0	225,105	11,443,817
FY94	0	0.00	0	0.00	0	0.00	0	0	194,161	11,637,978
FY95	1	0.63	0	0.00	1	0.63	0	0	158,422	11,796,400
FY96	1	0.75	0	0.00	1	0.75	0	0	133,959	11,930,359
FY97	0	0.00	0	0.00	0	0.00	0	0	135,011	12,065,370
FY98	0	0.00	1	0.71	1	0.71	0	0	141,448	12,206,818
FY99	0	0.00	0	0.00	0	0.00	0	0	141,575	12,348,393
*FY00	0	0.00	2	1.39	0	0.00	0	0	144,311	12,492,704
FY01	2	1.59	1	0.79	3	2.38	0	1	126,003	12,618,707
LIFETIME CY60-FY01	191	1.51	93	0.74	186	1.47	75	135	12,618,707	
5 YR AVG	0.4	0.29	0.8	0.58	0.8	0.58	0.0	0.2	137,670	
10 YR AVG	0.8	0.48	0.4	0.24	0.9	0.54	0.1	0.2	166,536	

T-38

YEAR	CLASS A #	CLASS A RATE	CLASS B #	CLASS B RATE	DESTROYED A/C	DESTROYED RATE	FATAL PILOT	ALL	HOURS	CUM HRS
FY92	0	0.00	0	0.00	0	0.00	0	0	11,005	280,268
FY93	0	0.00	0	0.00	0	0.00	0	0	9,179	289,447
FY94	0	0.00	0	0.00	0	0.00	0	0	7,069	296,516
FY95	0	0.00	0	0.00	0	0.00	0	0	7,917	304,433
FY96	1	14.28	0	0.00	1	14.28	2	35	7,003	311,436
*FY97	0	0.00	0	0.00	0	0.00	0	0	6,496	317,932
*FY98	0	0.00	0	0.00	0	0.00	0	0	4,866	322,798
*FY99	0	0.00	0	0.00	0	0.00	0	0	5,066	327,864
*FY00	0	0.00	0	0.00	0	0.00	0	0	5,782	333,646
FY01	0	0.00	0	0.00	0	0.00	0	0	5,565	339,221
LIFETIME CY74-FY01	1	0.29	6	1.77	1	0.29	2	35	339,221	
5 YR AVG	0	0.00	0	0.00	0	0.00	0	0	5,555	
10 YR AVG	0	1.02	0	0.00	0	1.02	0	3.5	9,761	

T-43

THE STRATEGIC AIRLIFTERS

C-5 C-17 C-141

USAF Photo

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Complacency is the biggest area in which we can continue to improve.

Introduction

Airlifters, we're doing well, but we can do better. FY01 was not the best year for Strategic Airlift, but not the worst either. Safety incidents cycle a little over time and last year we were slightly up on our rates. Minimizing rates is not the real goal; saving assets, to include personnel and aircraft, is our goal. Complacency is the biggest area in which we can continue to improve. Last year, complacency manifested itself in a lack of personal discipline and attention-to-detail, which led to the majority of the following mishaps. As I review the class A, B and C mishaps that occurred in FY 01, four unofficial categories jump out at me. Engines (18), Landing gear/brakes (9), Structural (12), and a smattering of other areas I'll call Miscellaneous (6). Let me begin with engines.

Engine Mishaps

The engines on large aircraft are expensive items. In fact, of the ten class B mishaps in the strategic community last year, nine were engine-related.

The C-5 Galaxy community had three mishaps.

- The first was discovered during preflight and consisted of damage to a single second-stage fan blade. It appeared the damage happened while the engine was static.
- The second was due to a bird strike on a touch-and-go. The crew successfully shut down the engine and landed uneventfully.
- The third engine mishap was due to FOD. During a ground maintenance engine run, FOD was ingested into the engine, causing significant damage to several fan blades and the honeycomb structure around them.

The C-17 Globemaster III led the way (*not* a good thing, in this case) with ten engine mishaps, and seven—repeat, *seven*—of them were due to FOD. There were three non-FOD reports.

- A computer malfunction led to improper engine response on run-up for a static takeoff. Additional damage to the engine occurred during maintenance troubleshooting after the jet was returned to parking.
- The second event happened when a Permanent Magnet Alternator (PMA) was contaminated. The PMA stopped powering both channels of the Electronic Engine Control (EEC). As advertised, when both channels failed, the engine reverted to "Safe" mode, with minimum fuel flow. Subsequent, intermittent PMA power led to other malfunctions that required an engine change.
- The third incident is still under investigation. Initial reports indicate there was an oil filter 4 Warning Annunciator Panel (WAP) indication, and then the engine rolled back on its own at FL 350. Talk to your local safety office for a copy of the final message when it is available.

The other seven C-17 engine mishaps resulted from FOD.

- Four were suspected bird strikes,

one ingested a stone, and another incident involving ice ingestion damaged three of the four engines, requiring a total of 50 fan blades to be replaced. This crew flew almost six hours to their next station before the damage was discovered. And finally, a crew unknowingly ingested FOD into two engines while backing over an unpaved surface to prepare for a combat offload. This crew took off again and flew the remaining five hours of their local.

The C-141 Starlifter had five engine mishaps, and all of them were in the Class B mishap dollar-value category.

• The first was due to accepted risk. A portion of the turbine failed on climbout, causing an engine failure. This type of failure has happened before, but through engineering analysis and safety review, the USAF has determined that these failures are an acceptable risk. The crew safely returned to base.

• The second mishap occurred during an engine run. Two engines were being run at 1.8 EPR to facilitate troubleshooting when one of the engines catastrophically failed.

• The other three mishaps were due to FOD. All FOD damage was found by maintenance and the damage was bad enough for the engines to be replaced. In each case, the aircrew that flew the flight prior to the damage discovery had no indication anything was wrong.

Engine failures due to mechanical problems will continue to be a factor we have to live with. While we continue to work with manufacturers to identify and improve reliability, sometimes things just break. Where we can help ourselves is by using proper mission planning techniques to avoid areas where there is a high potential for bird strikes.

If you've done the proper planning and you get to a low-level or transition field and notice a significant number of birds, go elsewhere or "incomplete" your training. An extra flight to accomplish your requirements is more beneficial to the USAF than losing an engine or, even worse, an entire aircraft and crew.

FOD: We all learn about FOD from Day One in our respective career fields. Be vigilant, follow the ASRR and Giant report information, and use common sense. If a situation looks bad, come up with another option or clean it up prior to operating in the area.

Landing Gear/Brake Mishaps

Now we'll get into the C-5's favorite area. Although landing gear/brake mishaps seem to be a constant for the C-5, the C-17 has taken over the lead in pure numbers for this category.

The C-5 community suffered two brake fires. One happened on landing, the other after an extensive taxi. Both appeared to be due to a dragging brake. Keep in mind that even when all brakes are operating properly, extensive taxi distance and/or maneuvering can increase brake temps beyond design limits.

The C-17 had four mishaps—three jacking incidents and one main landing gear failure. Both types of incidents have happened in the past.

• All of the jacking incidents could have been prevented had Maintainers followed T.O. guidance. Which prompts me to emphasize one simple fact: A strong training program and strict adherence to T.O. directives can prevent integral jacking incidents.

• As for the single C-17 MLG failure, the crew was taxiing out of the chocks when they were notified there was a problem with their aircraft. They deplaned the loadmaster who discovered that one of their MLG had suffered structural failure. This issue doesn't have a permanent fix yet. Several modifications have been implemented, but each has improved the reliability of only a portion of the structure. More to follow through safety and operations channels, so stay tuned.

The C-141 had three reportable gear mishaps this year.

• On one, the nose gear didn't center on extension. The crew followed the proper checklist, which centered the nose wheel and they landed uneventfully.

• The second incident occurred while the aircraft was being prepared for a mission. While sitting stationary on the ramp, the right main landing gear bogie broke. Mechanical failures caused these problems so, be advised: As the aircraft gets older, more incidents like this may occur.

• The third mishap involved a night landing with a "thump" on roll-out. The crew didn't see anything and after verifying they didn't have a flat tire, taxied to park. Closer inspection showed damage to the gear due to a deer strike. The aircraft suffered damage, but the deer paid the ultimate price. This shows that

continued on next page

Closer inspection showed damage to the gear due to a deer strike.

wildlife, other than birds, can cause damage to our aircraft. The next time the aircraft and crew might not be so lucky. Pay attention to the en route Sup and the ASRR as cows, deer and other wildlife *do* cohabitate our runways!

Structural Mishaps

Structural mishaps include anything that caused damage to the airframe itself that hasn't already been mentioned.

Unlike the engine category where the C-17 had the majority of the mishaps, the C-5 leads the way (again, *not* a good thing) with nine of the twelve in this category.

• A 40K-loader rammed the forward ramp extension, causing damage. The driver of the 40K-loader was distracted by an inanimate object in his cab and didn't follow loadmaster guidance to stop. Even when a job is fully briefed and progressing as planned, be prepared for the unexpected.

• There were three dropped objects this year. During the preflight after a RON, a crew discovered that the right wing, number four ground spoiler had delaminated in flight the previous day. When the spoiler came apart, it also damaged several other parts of the wing. The crew had no indications of the failure on the previous flight. The second object was a 2' by 8' piece of the number four right flap. Again, it was discovered the next day during preflight of the aircraft. It separated from the aircraft on a transoceanic flight and was never recovered. Post-mission walkarounds are required. They can identify problems before they cause subsequent mission delays. Be diligent and look over the entire aircraft's condition. The last incident occurred when a piece of the main landing gear track departed the aircraft at completion of a touch-and-go.

When the spoiler came apart, it also damaged several other parts of the wing.

• The next crew had a number one flap asymmetry occur while executing a three-engine go-around. The crew performed an uneventful, 40 percent flap, full stop. The part that failed was a fly-to-fail part.

• While taxiing out, a malfunction initiated a main bogie retraction on the ground. Several parts of the gear retraction system were damaged and replaced.

• During a nose landing gear re-pack, the nose landing gear broke catastrophically.

• A failure in the NLG system forced the next crew to land with the nose gear retracted. After the initial takeoff, they had an unsafe nose gear indication. The crew confirmed that the gear was up, but one nose door was partially open. After running all applicable checklists and using a conference skyhook, they determined that the nose gear could not be lowered and performed a main-gear-down, nose-gear-up landing. Crew and passengers deplaned unharmed.

• Another NLG problem led to the only strategic airlift Class A of the year. On take-off roll, the nose gear strut failed explosively, causing collateral damage to the aircraft outside of the nose wheel well. The crew rejected the takeoff and the aircraft came to rest on

the runway with the nose riding on the NLG outer cylinder strut.

The C-141 had three structural failures.

• The first was heat damage to a wing leading edge panel. The aircraft flew for over a month before the damage was noticed.

• The next event was a problem with the empennage deice system. During troubleshooting, maintenance found a burn hole in the empennage.

• The last event occurred when a portion of the radome failed in flight. It failed under normal flight conditions.

Miscellaneous Mishaps

• The C-5 and the C-141 weapons systems each had a weather-related mishap. A C-5 received a lightning strike that put a seven-inch hole in the radome. The C-141 mishap occurred during cruise at FL 370. They were IMC when they encountered severe weather. Post-mission inspection of the aircraft showed radome damage. Even though these crews did nothing wrong, they still felt the effects of Mother Nature. Continue to follow your AFI 11-2C-XXX adverse weather guidance and weather-related incidents will remain low.

• A C-5 APU failed and caught fire on the ground. It took two fire bottles to extinguish the fire.

• Two inadvertent emergency escape slide deployments occurred in the last year and they were nearly identical. While the loadmasters were attempting to stow the slide in its storage compartment, an exposed deployment cable caught on something and activated the slide. Know where that wire is and ensure its unencumbered entrance to the storage compartment.

• The last incident occurred while towing a C-5 to the hot cargo spot of a fighter base that is supported by many large transient aircraft. The end result was damage to the right wing tip when it struck a tree 139 feet from centerline of the taxiway. The aircraft was approximately 30 feet off centerline when the incident occurred. Tow crews, familiarize yourself with the areas you'll be maneuvering in, follow the checklist, proceed with caution and if something doesn't look or feel right, STOP!

Conclusion

Once again, we proved this past year that things break and people make mistakes. Both are normally acceptable. Not so in the life of an Airlifter or Maintainer. Normal, scheduled inspections of the airframes should catch the mechanical breaks before they happen. Personal discipline and attention to detail could have prevented the majority of these mishaps. Strong training programs and *using* required guidance should limit individual mistakes.

I need to emphasize that the Airlift community is doing a good job minimizing mishaps, but like everyone else, we can do better. Pay attention to what you're doing, use your checklist and above all else, listen to your brain and your gut, i.e., use common sense. Don't let any part of your job become "routine." If something doesn't look, feel or smell right, it probably isn't. Remember: A shortcut can kill someone and that someone may be you!

The right wing tip struck a tree 139 feet from centerline of the taxiway.

USAF Photo

TRAINERS

Engine problems and the Tweet seem inseparable.

MAJOR MIKE FOLKERTS
HQ AFSC/SEFF

T-37 Tweet

Hard to believe the first UPT class to train in the T-37 was Class 59-9 …over forty years ago at Bainbridge AFB, GA! Even though the Tweet is marching steadily towards the boneyard, for now it remains AETC's pilot training workhorse. In FY01, the Tweet flew over 169,000 hours, which is more than any other trainer aircraft. The T-37 community suffered one Class A mishap last year, bringing the Tweet's last 10-year total to seven Class A mishaps. To put that figure in perspective, in its first 10 years of operation (1957-1966) the T-37 was involved in 73 Class A mishaps. So while one mishap may seem like too many, we've come a long way in reducing our totals!

One benefit of growing old is predictability; the narratives of many of this year's mishaps are strikingly similar to previous years. A piece of good news was the significant drop in Class Cs, from 49 in FY00 to 19 in FY00, so it looks like the LG community has made some good fixes. Even so, engine problems and the Tweet seem inseparable, as the J69 powerplant has historically been the Achilles' heel of the T-37. FY01 was no exception, as 15 out of the 19 Class C mishaps were engine-related. While you need to be prepared for any emergency or condition, the wily aviator focuses on maintaining *proficiency*—not just *currency*—with single-engine procedures and operations.

As far as operator issues are concerned, physiological incidents involving GLOC far outpaced all other reportable mishaps, with inadequate anti-G straining maneuvers by student pilots leading the way. Twenty-four GLOC incidents occurred in the T-37 last year. Historically, the Tweet accounts for 80 percent of all Air Force GLOC incidents. With an unpressurized cockpit, very limited air conditioning and an exceptionally high G-onset rate, the benign-appearing Tweet has the power to put one to sleep. Quickly. Be sure to focus your efforts on high-quality instruction and evaluation of your student's anti-G straining maneuver.

Class A GLOC (Sep 01). The mission was a solo syllabus sortie, which called for the student to practice aerobatics. The student flew the departure to his training area and attempted a G-aware-

USAF Photo

ness exercise. Soon after entering the turn, he found himself in a nose-low attitude and attempted a nose-low recovery by selecting idle power and extending the speedbrake. He began to roll wings level and increased back-pressure. The student began to gray out, but remained focused on reducing his airspeed from the nose-low attitude. Because he channelized his attention on airspeed, his anti-G straining maneuver (AGSM) was ineffective and he GLOC'd. Right after "waking up," the student attempted to make control inputs to fly the aircraft, but put the aircraft into a spin instead. He recognized a bad situation and ejected successfully. When the student channelized attention on airspeed at the expense of an effective AGSM, he made a very common error that strikes pilots of all experience levels. Challenge yourself to think about what actions and techniques you can take to guard against channelized attention, and teach them to your students.

The student's ejection decision/training was the silver lining in a stormy cloud. The student pilot made a timely, but difficult, decision to eject while in a reduced state of post-GLOC consciousness. Prior to the mishap sortie, the student had extensive discussions with IPs and received safety briefings concerning the ejection decision. This laid a solid foundation for him to formulate his own clearly thought-out decision process. This mishap highlights the importance of thinking through emergencies and critical response items while on the ground.

T-38 Talon

In FY01, the Talon flew over 126,000 hours. The T-38 community suffered two Class A mishaps last year, which calculates to a rate of 1.59 per 100,000 flying hours. This rate is very close to the historical average of 1.55 since the T-38 started flying, but definitely not what the T-38 world has grown accustomed to the last few years. In fact, the last year with more than one Class A was FY93. Of the two Class A mishaps this year, one was operator-induced and the other involved material failure. On the positive side, Class C and Class E rates dropped compared to the previous year.

Loss of Control (Dec 00). The sortie was a two-ship dual formation mission. Shortly before the mishap, the student was performing a G-awareness mission. While rolling wings level, he felt a "burble" on the flight controls, similar to fly-

continued on next page

The student began to gray out, but remained focused on reducing his airspeed.

ing through jet wash. Immediately after, the aircraft made an abrupt and uncommanded pitch up and roll to the left. The instructor took control of the aircraft shortly thereafter with approximately 120 degrees of bank and nose slightly above the horizon. The instructor was able to recover the aircraft to an upright position using ailerons; however, the aircraft entered a series of uncommanded rolling and pitching maneuvers. The instructor was unable to regain control of the aircraft and, passing through 9500′ MSL, directed ejection. Analysis of the wreckage revealed a fatigue break in the left servo valve control rod-end, which rendered the aircraft uncontrollable.

Aug 01 Midair Collision. This sortie involved a two-ship formation mission to the area, with a solo student in the lead position. During fighting wing maneuvers, the student in the dual aircraft flew to a position at the right 3 to 4 o'clock position of lead, from which he attempted to lag to maintain position. The combination of this lag maneuver to the left and lead's entry into a right hand barrel roll maneuver put the flight into a situation where lead was in the sun. The IP asked his student if he had lead in sight, to which he replied that he did. Uncertain that the student could correctly assess angle-off and closure, the IP took control of the aircraft and initiated a negative-G maneuver. Simultaneously with this maneuver, both IP and student testified they saw a shadow off to the right and high, followed immediately by the collision. Although the dual crew was able to successfully eject, the solo student pilot was fatally injured.

They saw a shadow off to the right and high, followed immediately by the collision.

The IP did not anticipate the sequence of maneuvers, which placed the solo lead in the sun and allowed an uncomfortable situation to mature. He took the aircraft and initiated corrective action too late. Barrel rolls with lead in the sun are a bad combination, especially when entered from a poor aspect angle. Instructors recognize that one of the toughest jobs they have is deciding how far to let a student go. For new IPs especially, like the one in this mishap, never be afraid to keep your student on a short leash.

Flameouts/Compressor Stalls. T-38 aviators know the J85 has always been touchy when operated near the edge of its operating envelope. This fact was evident in the majority of last year's Class E incidents. The impact of JP-8 on the operating envelope has raised concerns from the field. At the time of this article's publication, the systems program office at Hill AFB is conducting an evaluation to determine if the change to JP-8 has altered the operating envelope. Regardless of the outcome of this evaluation, making judicious throttle movements when near the edge of the envelope and paying attention to critical factors like OAT may help reduce the rate of unintentional single-engine operations.

T-1 Jayhawk

Flying over 94,000 hours, the T-1 experienced another stellar year in FY01. There were no Class A mishaps last year, which continues a streak started back in 1992 at Reese AFB, TX. The only other USAF aircraft produced in significant numbers (not counting the "one-or-two-each" UV-18, etc.) that can make this "no Class As" claim is the C-20. All personnel involved in T-1A flying are justified in being proud of their accomplishments, but at the same time should guard against complacency.

For FY01, there were two Class B mishaps and four Class C mishaps. Of these six mishaps, five involved engine system issues. Thirty-two Class E and High Accident Potential (HAPs) incidents were reported, with the majority of these involving either smoke/fumes in the cockpit or flight control malfunctions. Keep in mind that the difference between a Class E or HAP and a Class A mishap, for the aircrew, is often only a matter of seconds or feet. For Maintainers, this difference can be a few millimeters or a few foot-pounds. Later in this article, you'll find logistics measures taken in response to the flight control incidents.

April 00 Class B. The mission involved a ferry flight of maintenance personnel. To comply with max takeoff weight, the crew flew some patterns prior to the maintenance crew boarding. This necessitated a heavyweight, full stop landing. On the ensuing takeoff, the aircraft started pulling to the right due to a tire deflation. During the abort, the right side brakes locked up, causing the tire to explode, with pieces ingested into the engine. There are some important operational issues regarding this incident, but safety privilege prevents me from discussing them. If you have not received a briefing on this incident, stop by your friendly squadron safety shop, where they can fill you in and/or show you the final safety message.

Flight Control Incidents. For a good example of how a minor incident could quickly turn into a Class A, consider the T-1's flight control incidents of the last year. Fourteen of these flight control incidents were reported as Class E incidents or HAPs last year. In response to binding flight control reports, an urgent action TCTO was drafted, which directed the inspection, cleaning and lubrication of the rudder and elevator servo mount clutch plates. Since the TCTO's release in Jun 01, over 35K flight hours have been flown with no flight control binding incidents. On the other hand, uncommanded autopilot engagements remain an unresolved issue. Be sure to report any and all incidents so the LG community has the opportunity to get to the root cause of these mishaps. When it makes sense, (i.e., you are on the ground) try to avoid troubleshooting, so maintenance personnel can see the problem "as is."

T-6A Texan II

The "Texan II" started training students at Moody AFB in November of 2001, and is well on its way to proving itself a great student trainer. The T-6A had an admirable safety record last year, with no Class As and only 1 Class B mishap. Texan II flying hours are definitely ramping up, as it flew over 15,000 of them last year. As the T-6 matures, it is critical that you report *all* safety incidents, so the bugs can get worked out. If ever in doubt about whether to report an incident, talk to your friendly squadron or wing FSO.

The introduction of a propeller-equipped aircraft with only one engine and tandem seating is a major change to the way the USAF trains its pilots. Primary instructors are going to have to get used to not being able to see everything that the student does. Anticipating student errors will take on increased importance. For example, developing a habit of guarding the throttle to prevent a student from inadvertently selecting cutoff, especially during the response to a simulated emergency, is something to consider. For previous Tweet instructors, choosing your words a little more carefully will be critical. The tandem cockpit definitely increases the potential for misunderstandings and human factors errors, especially with young aviators.

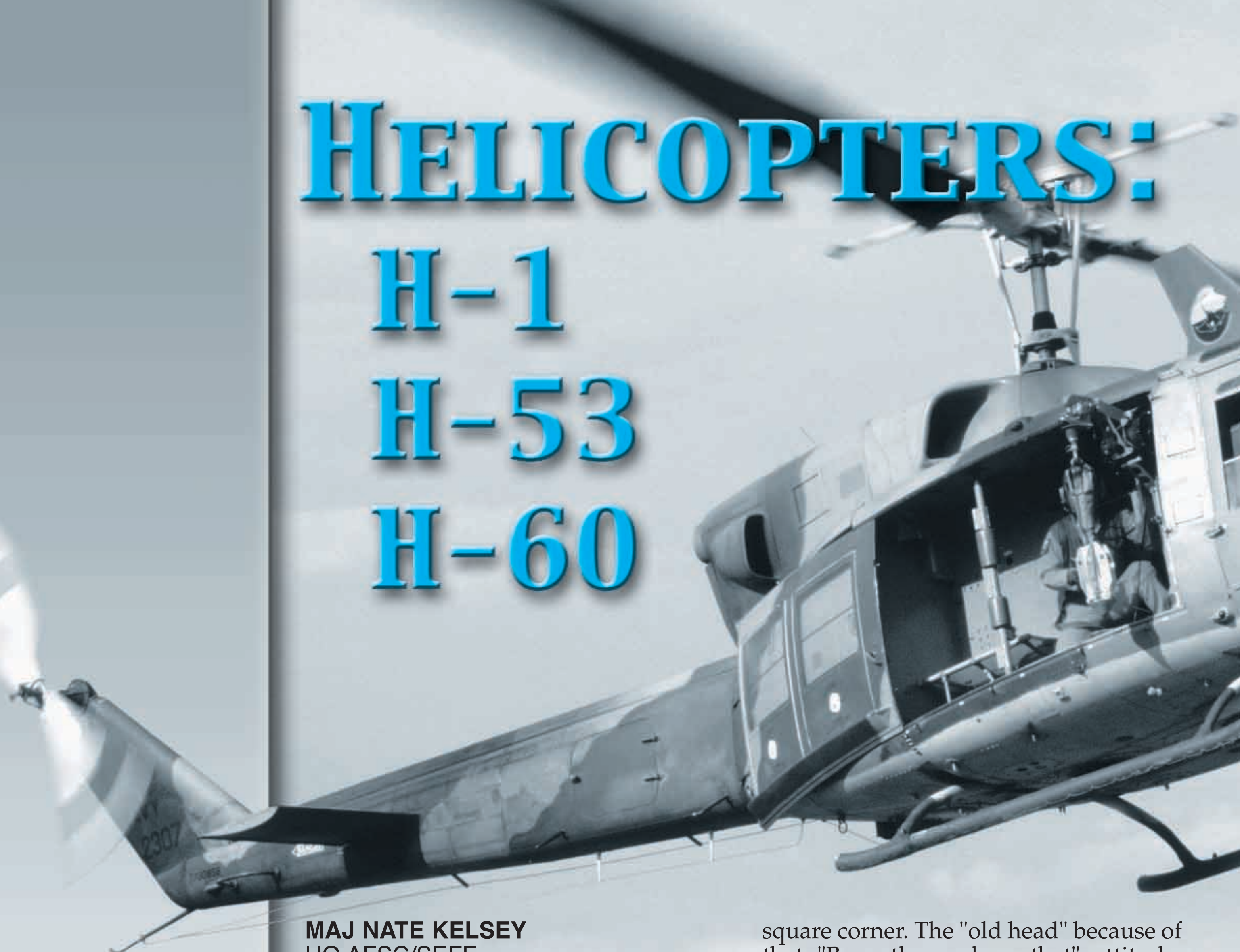
Aug 01 Class B. The mishap occurred during a spin sortie. The pilot initiated an aggravated spin maneuver with eleven-and-a-half rotations, including pull out of the maneuver. During the aggravated spin maneuver, the engine oil pressure dropped below 40 psi, to a minimum of 17 psi, for approximately 12 seconds. Upon recovering from the spin maneuver, the "Chip" light was illuminated on the Master Caution/Warning panel. The pilot initiated the emergency procedure for a chip light by reducing power and preparing for an emergency landing. The oil pressure began a steady decrease and oil temperature steadily increased. About seven minutes after the chip light illuminated, the pilot noted a puff of smoke from the right exhaust stack, accompanied by a loud bang. The aircraft vibrated violently and oil pressure continued to drop. The pilot shut down the engine and performed an uneventful emergency landing pattern to his home base. This mishap has several very important lessons learned and factors to consider. If you're flying the T-6A and haven't received a briefing on this mishap, see your squadron safety officer, who can fill you in and/or show you the safety investigation board's final message.

Summary

The trainer community did an outstanding job (again!) in FY01. Given the utilization rates, harsh environments, and pilot experience levels that the Tweet, Talon, Jayhawk and Texan II are exposed to, it would be difficult for any aircraft to have a better safety record. All aviators, Maintainers and support personnel are to be commended for their efforts during some very long workdays. Keeping pace with the high-tempo operations of the last year has been an accomplishment to be proud of. Continue your outstanding work and remember to FLY SAFE. The life you save might be your own!

The pilot noted a puff of smoke from the right exhaust stack, accompanied by a loud bang.

HELICOPTERS: H-1 H-53 H-60



MAJ NATE KELSEY
HQ AFSC/SEFF

Recognize a bad situation about to turn worse.

My first helicopter instructor pilot used to say: "Helicopters fly by beating the air into submission." While this may not be entirely true, the safety record of our rotary wing bro's is hard to beat. With an FY01 Class A mishap rate of 0.00 per 100,000 hours, our fleet of helos did an admirable job of hovering towards an incredible safety record.

The Safety Center puts together this end-of-fiscal-year edition to prevent a repeat of a particular mishap. We do that by getting the word out. Spreading "lessons learned" should pay dividends in mishap prevention by using someone else's unfortunate experience. I'm confident, however, that there's some "nugget," or some "old head" who'll think of new and exciting ways to break or bend Uncle Sam's inventory. I say "nugget" because they don't have any experience to speak of, so they don't recognize when they're getting into a square corner. The "old head" because of that "Been there, done that" attitude. The only difference between the two is the "old head" will recognize his mistake when he does it again. This is sometimes referred to as "experience." Maybe this article will take the place of personal experience and you'll recognize a bad situation about to turn worse, *before* you get "up against the wall."

The only events that could be loosely termed a trend would be smoke and fumes in the cockpit; there were three of these. Here are some other notable mishaps which occurred during the last fiscal year.

Mishap Fall

The mishap flight engineer (MFE) was accomplishing a routine preflight inspection on top of the helicopter. Weather at the time of the mishap was light snow mixed with rain. While stepping from the forward hydraulic cowling area to right engine intake area, the MFE's feet slipped, causing him to fall

USAF Photo

to the ground. He broke a wrist in several places and was unable to fly for almost three months.

H-53M

This incident occurred while inserting a team at night into an LZ in white-out conditions. Landing zone weather was 500 ft ceiling with two miles visibility and about two to three inches of fresh snow on the ground. A slight upslope was in the portion of the LZ where the aircraft landed. Onboard sensors had ID'd several obstacles in the LZ, including the mishap fence posts. The mishap aircrew attempted to fly the aircraft clear of the obstacles while on final approach. Just prior to touchdown, the aircraft entered white-out conditions, as expected. The aircraft commander continued the approach to the ground and inadvertently contacted the tops of three fence posts.

Torque was maintained until the aircraft was stabilized and safely on the ground. The crew inspected the outside and underbelly of the aircraft and noticed some damage. The landing gear was visually inspected prior to takeoff and was deemed fit for flight. During the RTB, the gear was left down. The helo returned without incident. A visual inspection by another aircraft revealed no significant damage. The helicopter hover-taxied to a safe spot and was shut down without incident. The crew followed all necessary procedures for conducting a white-out landing. Although the crew knew of the obstacles and lost sight on short final, they did attempt to maneuver the aircraft to avoid the fence prior to entering white-out conditions, and they thought they had cleared the fence. At no time did the crew feel unsafe during the approach, so no go-around was executed.

MH-53J

At some point during the sortie, the .50 caliber link ejection chute came out of the left window. Links from the chute were ejected into the slipstream in front of the left sponson, peppering it. Some links migrated along the left fuselage, leaving small scratches. One link flew into the tail rotor, causing damage beyond repair limits. It is believed that the same link was thrown into a main rotor blade, causing damage beyond repair limits. The damage was not noticed during the flight.

Combat Rubber Raiding Craft (CRRC)

The mishap aircraft departed home station to a local water drop zone. During CRRC deployment, the nose of the craft was caught up by the rotor wash and struck the tail rotor. Damage to the rotor caused severe vibration, forcing the crew to make an emergency landing at a nearby landing site. Debris struck one of the deploying special tactics squadron (STS) airmen in the arm, causing substantial injury. The airman was transported to the local hospital and received medical treatment.

As Safety Center reps, we are constantly asking "Why?" Trying to get to the root cause of an accident is not a simple matter. So get in the habit of asking yourself when you're about to do something unfamiliar, "What would the Board President say?" Then follow up with "Why did they do that?" It will shed some light on why we do the things we do.

I'll leave you with a Zen quote: "Talk doesn't cook rice."

Just prior to touchdown, the aircraft entered white-out conditions, as expected.

C-130

MAJ MIKE FOLKERTS
HQ AFSC/SEFF

During landing roll, the No. 4 propeller and right side of the fuselage contacted the ground.

With the tragic events of September 11th, this past year is certainly one that none of us will soon forget. At the time of the writing of this article, military operations are ongoing. Godspeed to the crews who are participating in some very challenging missions.

For the Herc world this past year, mishap rates remained fairly consistent with the previous few years. There were two C-130 Class A mishaps in FY01, which works out to a rate of 0.71 per 100,000 hours. Fortunately, neither of these involved a fatality. Ten Class Bs occurred in FY01, versus 12 in FY00.

Jun 01 Class A

This mishap occurred during an off-station trainer. After a touch-and-go landing, the crew declared an inflight emergency for a right main landing gear retracked malfunction. After discussing options with manufacturer representatives, the crew extended the left main gear and nose gear, but did not extend the right main landing gear. During landing roll, the No. 4 propeller and right side of the fuselage contacted the ground, and the propeller departed the aircraft. The aircraft departed the runway and the right wingtip struck the ground. This mishap has several very important lessons learned for aircrews as well as Maintainers. If you haven’t received a briefing on this mishap, see your squadron safety officer, who can show you the safety investigation board’s final message.

Sep 01 Class A

Last year’s second Class A occurred on a night, single-ship tactical mission. Approximately one hour into the sortie, the crew felt unusual vibrations in the No. 4 engine. When the mishap engine failed, a fire started. The crew shut down the engine using emergency shutdown procedures, firing both fire bottles. When the fire continued burning after about five minutes, the complete engine, along with the gearbox and propeller, departed the wing. The aircraft safely landed at the nearest suitable airfield. There were no injuries to the aircrew or anyone on the ground.

Turbine Failures

Besides the Class A mentioned previously, the Hercules fleet has experienced an increased rate of turbine failures during FY01. Congratulations to the crews, who did an outstanding job handling these inflight emergencies. Valid concerns have been raised on the need to reverse this trend and keep our crews off the "hot seat." The good news is that there are some turbine fixes coming down the logistics pipeline. By spring of 2002, improved first-stage turbine blades will be available for installation. Also, the redesign for the fourth stage turbine wheel should be complete by Feb 2002.

In the meantime, there are some areas to focus on as crewmembers that can extend turbine life and spot a turbine "on

USAF Photo

its last legs." If you notice low torque (even just a few hundred inch-pounds) on an engine, be sure to let maintenance check it out. A motor missing torque is often the first sign of a turbine problem. Also, continue to be vigilant for thermocouple failures, which are often displayed by a "cold start." By letting maintenance swap out these bad thermocouples, you will save the turbine from being exposed unnecessarily to high TITs. Third, be disciplined about setting reduced TITs during cruise and try to avoid rapid throttle movements. Both of these methods will go a long way toward extending turbine life. Finally, be conservative with your actions when confronted with an unusual engine vibration or rough-running engine.

Hot Brakes

During the last year, there were several incidents involving aircraft damage caused by hot brakes. Most occurred after either assault zone work or no-flap landings to a full stop. Although the Herc brakes do a great job of absorbing a lot of energy, be sure to treat them with respect. If you hear the brakes making noises (the infamous groan) or starting to stick, ensure you give them plenty of cooling time. With any indications of your brakes heating up, think long and hard before setting the parking brake, as this only worsens the heat buildup. Finally, give your brakes a break (sorry) and taxi with three or four engines downsped.

Smoke/Fumes

There is no shortage of things burning up as the Herc ages. During the last year, 22 smoke and fumes incidents were reported—one of them even caused Class B damage. Be alert for water in the cockpit from condensation or after a rain shower (or your spilled Coke). If you smell a strange odor (and nobody called "Howdy"), be sure to take the conservative path. There is certainly a lot more to lose than gain by *not* donning the oxygen mask, even if the culprit turns out to be a musty air conditioner sock.

Fasten Seat Belt Light—ON

Unfortunately, several AMC aircrew members were badly injured due to inflight turbulence last year. If a maneuver or potential turbulence is coming up, make sure to communicate this fact to the folks in the back so they can take precautions. Having slept in a hammock attached back by the ramp during a long flight, I am ill-equipped to preach, but always be sure to weigh the potential risks of walking/lying around in the cargo compartment.

Operational Risk Management (ORM)

Congratulations to all the great ORM programs out there. AMC and C-130s are definitely leading the pack when it comes to implementing creative programs to mitigate risk and still hack the mission. Keep up the great work. The AMC Safety shop has gathered some of the best ORM programs from the field, and has them available for your unit. During contingency missions, the acceptable level of risk obviously goes up. The uncertain and fluid nature of these missions demands that we pay even *more* attention to risk management, not less. Make sure you are communicating the risks of these rapidly changing missions to your squadron leadership.

Keep up the great work and remember: *You* are the eyes and ears of the safety program. If you are not taking an active role in the safety process, *do*! Let your safety shop know when you notice anything that's "not quite right." With the events of September 11th and the resulting operations, it's easy to get distracted. Let's keep the focus on safe operations and show America and the rest of the world who puts the "air" in "airlift."

During the last year, 22 smoke and fumes incidents were reported.

FY01 Engine-Related Mishap Summary

BILL BRADFORD
CAPT TOM FEHRINGER
RICH GREENWOOD
JOHN MAYNARD
HQ AFSC/SEFE

HQ AFSC Photo by Rich Greenwood

Over the last five years, 29 of the 34 engine-related destroyed aircraft have been in the single-engine F-16 aircraft.

(Information in this article came from Accident Investigation Board Reports and/or Part 1 of Safety Investigation Board Reports. None of this material was derived from privileged communications. Ed.)

Overview

Let's take a look at FY01 engine-related mishaps by beginning with a review of Figure 1, our standard leadoff chart. This figure illustrates the percentage of engine-related destroyed aircraft mishaps to all destroyed aircraft mishaps. It shows that engine-related destroyed aircraft mishaps are more than double the percentage for FY00. A look at the actual numbers of engine-related destroyed vs. total destroyed shows the split is 3/17 for FY00 but 8/21 for FY01. Before you jump to a conclusion that the sky is falling, however, take note that the numbers we're using are, relatively speaking, very small. A difference of one or two mishaps can result in significant changes in the percentages over the years and is responsible for the "Grandpa's Teeth" shape of the chart. For the past eight years this percentage has averaged about 30 percent. It is also worthy to note that over the last five years, 29 of the 34 engine-related destroyed aircraft have been in the single-engine F-16 aircraft.

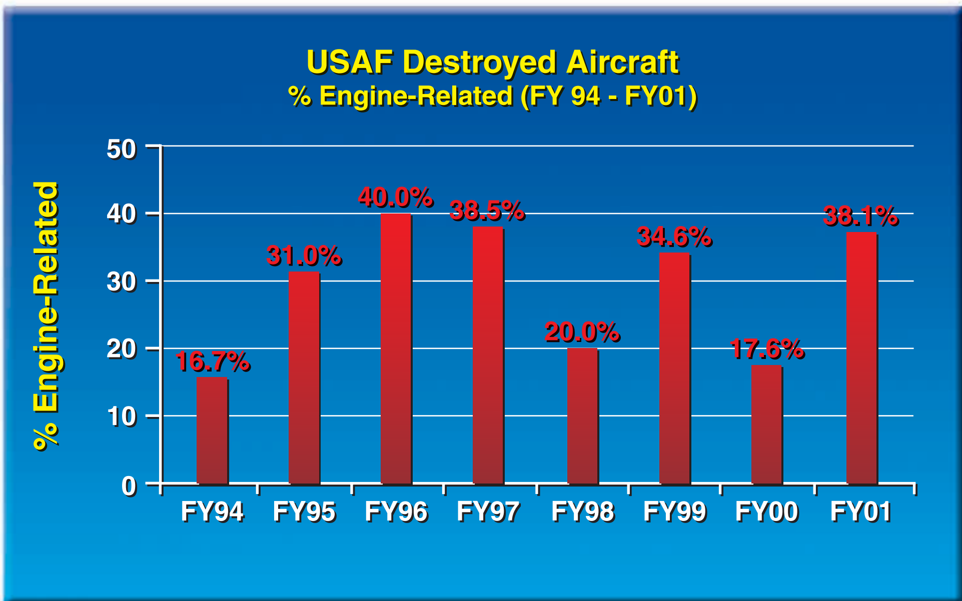


Figure 1

Next, in Figure 2 (right), we show the drivers of the FY01 Destroyed Aircraft mishaps. (After all, what would a magazine article written by engineers be without pie charts?) As said before, although Figure 1 might lead you to believe the engine-related percentage is high, we see the "Operations" portion of the pie is even higher. Details of the non-engine-related mishaps can be found in the aircraft-specific articles elsewhere in this issue. Conspicuous by their absence this year, are destroyed aircraft due to bird strikes—good news for aviators and the USAF BASH Team (the birds, too!).

FY01 Destroyed Aircraft "Drivers"

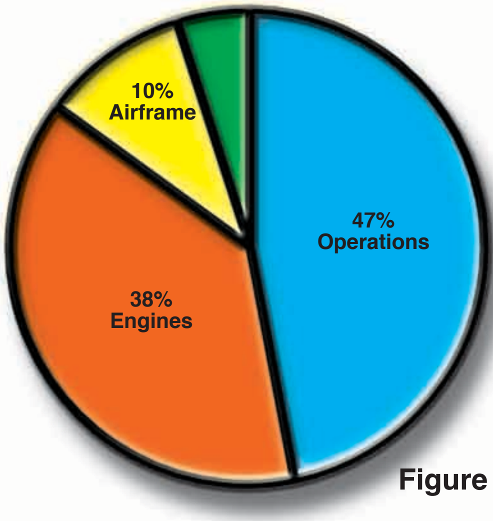


Figure 2

FY01 Engine-Related Destroyed Aircraft: By Engine Section

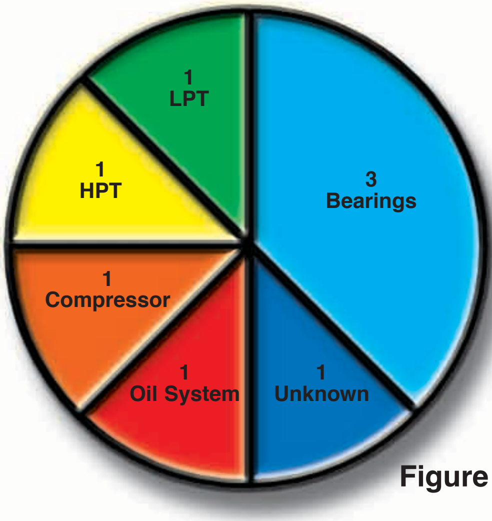


Figure 3

Engine-Related Destroyed Aircraft By Engine Section

Examining particular engine areas that brought down airplanes in FY01, we present Figure 3 (left). Except for engine bearings, what we have here is pretty much "one-sies," with no "two-sies." In the case of the single "Unknown," the mishap aircraft impacted the water and wasn't recovered, so the engine couldn't be inspected to conclusively determine failure cause.

Figure 4 (right) provides a snapshot of mishap factors. Of the eight engine-related mishaps that resulted in a destroyed aircraft for FY01, one of them was directly related to incorrect engine assembly procedures at depot ("Maintenance"). One was attributed solely to field maintenance procedures (another "Maintenance"), while another was a combination of field maintenance with an assist from the pilot (score one each for "Maintenance" and "Operations"). Two of the mishaps involved failure modes which have caused mishaps before and are currently being addressed through component upgrades ("Logistics"). And there were three in the "Other" category—one from a previously undetected FOD event and two that remain "unknown." Obviously, attention to detail in the assembly and maintenance of engines is of paramount importance in keeping a single-engine fleet safe, along with aggressive incorporation of design fixes for known problems.

FY01 Engine-Related Destroyed Aircraft: Factors

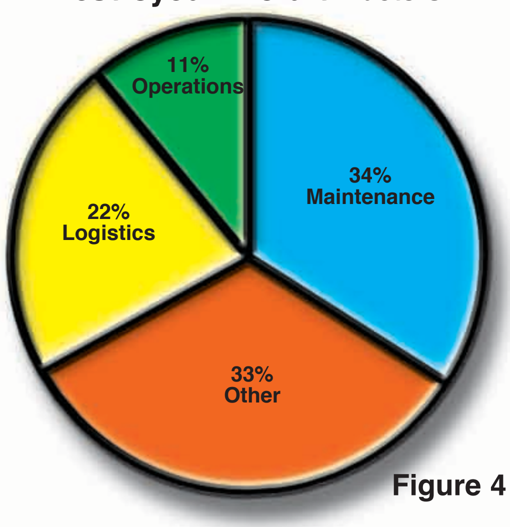


Figure 4

Attention to detail in the assembly and maintenance of engines is of paramount importance in keeping a single-engine fleet safe.

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F-15 and F-16 Mishap Rates

Now let's look at the engine-related destroyed aircraft rates for two of the more "visible" aircraft, the F-15 and the F-16. The rates are in destroyed aircraft per 100,000 engine flight hours (EFH). Table 1 shows the rates for the last three years for the three different engines used in the F-15.

F-15 Engine-Related Destroyed Aircraft / 100K EFH						
Fiscal Year	FY99		FY00		FY01	
Engine	Aircraft Losses	FY99 Rate	Aircraft Losses	FY00 Rate	Aircraft Losses	FY01 Rate
F100-PW-100	0	0.00	0	0.00	0	0.00
F100-PW-220	0	0.00	0	0.00	0	0.00
F100-PW-229	0	0.00	0	0.00	0	0.00
All Engines	0	0.00	0	0.00	0	0.00

Table 1

Pretty impressive, huh? It's obvious that a sound design, good maintenance practices, aggressive incorporation of fixes for known problems and detailed inspections all contributed to this impressive record. Having a second engine doesn't hurt either!

F-16 Engine-Related Destroyed Aircraft / 100K EFH						
Fiscal Year	FY99		FY00		FY01	
Engine	Aircraft Losses	FY99 Rate	Aircraft Losses	FY00 Rate	Aircraft Losses	FY01 Rate
F100-PW-200	0	0.00	0	0.00	0	0.00
F100-PW-220	5	3.98	2	1.59	2	1.72
F100-PW-229	0	0.00	0	0.00	0	0.00
F110-GE-100	3	2.04	1	0.74	4	2.76
F110-GE-129	1	1.55	0	0.00	1	1.77
All Engines	9	2.53	3	0.87	7	2.08

Table 2

On the F-16 side of the house, the numbers are shown in Table 2.

FY01 looks better than FY99, but not nearly as good as FY00. As pointed out before, however, with the small numbers we're looking at, the statistical significance of these rates is debatable. We've already discussed the engine areas and factors that contributed to this year's rates. Now let's take a look at each of these eight mishaps in more detail, including the one engine-related mishap that resulted in a destroyed A-10.

F110 Engine-Related Mishaps

There were five engine-related destroyed aircraft mishaps in the USAF F110 engine family, all of them occurring in the F-16 aircraft. Four involved the F110-GE-100 and one involved the F110-GE-129.

The first F110-GE–100 mishap occurred during a local training mission when the mishap pilot (MP) experienced an engine rumble. After trying to clear the rumble/noise using throttle movements, the MP turned the mishap aircraft (MA) back toward home station. The MA caught fire during the return leg and the MP shut down the engine, but the fire continued. The MP ejected safely and the aircraft impacted the water approximately 20 miles offshore. The search effort for the aircraft and engine proved futile and was called off after two weeks. To this date the mishap aircraft has not been recovered.

The MP ejected safely and the aircraft impacted the water approximately 20 miles offshore.

The next F110-GE-100 mishap occurred during a low-altitude intercept mission. During the G-awareness exercise the MP heard a loud bang, followed by a succession of bangs and an RPM rollback. Three airstart attempts were unsuccessful, forcing the MP to eject.

Engine teardown and inspection revealed a failed No. 3 main thrust bearing. *(The No. 3 bearing supports the front of the high pressure compressor [HPC]. Ed.)* While the main chip detector wasn't found, it's evident from maintenance documentation and hardware inspection that the bearing was in the process of failing for quite some time. Oil filters changed prior to the mishap flight contained metal debris. Another complicating factor was the unit's SEM/EDX *(Scanning Electron Microscope/Energy Dispersive spectroscopy via X-Ray. Ed.)* oil sampling machine was out of commission. Since this mishap, much effort has been put into obtaining additional SEM/EDX machines for all F-16/F110 units. As of this writing *(Oct 01. Ed.)*, this is scheduled to be completed by the end of FY03. Tech data is also being reviewed to highlight filter inspections with respect to the type of debris. Estimated completion date for incorporating revised tech data is the second quarter of FY02.

The third F110-GE-100 mishap occurred while in a cruise portion of the mission. The MP heard a bang, followed by a buzzing sound and decreasing RPM. The engine stabilized at sub-idle, but didn't respond to throttle movement. The MP shut down the engine, attempted several unsuccessful re-starts and subsequently ejected. Inspection of the mishap engine revealed a failed No. 4 bearing. *(The No. 4 bearing supports the rear of the HPC and the high pressure turbine. Ed.)* We've experienced this failure mode previously in the F110-GE-100 engine and a couple of actions are currently underway to reduce the risk of No. 4 bearing failures in the F110-powered F-16 fleet. These fixes include accelerated procurement of SEM/EDX machines for oil analysis, as mentioned above, and a new No. 4 outer bearing lock ring to improve chip migration and allow better detection of impending failures. Long-term action, involving redesign of the high pressure rotor for increased critical speed margin, is being accomplished as part of the F110 mid-life upgrade effort. This redesign effort is currently in the "drawing board" stage.

The fourth F110-GE-100 mishap occurred during a local training mission. During augmentor selection, the MP noted heavy vibrations followed by loss of thrust. He attempted an airstart, but it proved unsuccessful and he ejected. Mishap engine teardown and investigation revealed a high pressure turbine (HPT) disk post had failed, precipitating a blade release. At the time of this mishap, the field was in the process of removing higher-time disks from service. Since this mishap, these high-time disks are being removed from service at a much more robust pace. The final fix for this failure mode is a redesigned, "drop-in" HPT disk that is, at this time *(Oct 01. Ed.)*, scheduled for field introduction during the fourth quarter of FY02.

The single F110-GE-129 mishap also occurred during a local training mission. After rolling out and heading away from the target, the MP heard a "pop" followed by a buzzing noise. The MP retarded the throttle, but observed engine temperature continuing to rise and decreasing RPM. The MP shut down the engine and made a successful airstart. However, when the MP advanced the throttle to military, there was another loud pop and RPM again started winding down. The MP in this mishap also ejected successfully. Engine teardown revealed a 3rd stage compressor airfoil had released due to a high cycle fatigue crack. This crack began with leading edge damage (nick/tear) attributed to FOD or some other unknown cause. Tech data-specified compressor inspection intervals are currently being reviewed for possible change.

Since this mishap, these high-time disks are being removed from service at a much more robust pace.

F100 Engine-Related Mishaps

There were only two engine-related destroyed aircraft in the USAF F100-powered F-16 fleet during FY01.

The first involved a single-seat Block 42 F-16CG with an F100-PW-220 operating as part of a six-ship air combat tactics mission. Takeoff and flight to the MOA were uneventful. The MP was lead of the six-ship in a 2 v 4 engagement. While setting up for the engagement, the MP heard a loud bang and the engine experienced a rapid loss of RPM. Simultaneously, the MP's wingman reported dense white smoke coming from the MA's exhaust nozzle. After two unsuccessful airstart attempts, the wingman told the MP his aircraft was on fire. Shortly thereafter, the MP successfully ejected and was recovered with only minor injuries. The MA rolled right and pitched down to approximately an 80-degree nose-down attitude, impacting the ground in a cow pasture at over 500 KIAS.

continued on next page

Improper assembly of the scoop led to uneven loading of the bearing, which, in turn, resulted in premature failure.

Investigation determined the engine seized due to sudden, catastrophic failure of the No. 3 bearing. Laboratory examination showed the bearing inner race scoop had been improperly assembled during previous depot maintenance on the engine core module. Improper assembly of the scoop led to uneven loading of the bearing, which, in turn, resulted in premature failure. Bearing failure resulted in engine seizure, disconnection of the gearbox drive shaft and subsequent loss of fuel pressure, oil pressure and electrical power. An extensive review of depot maintenance procedures resulted in changes to mechanic training, assembly tooling and assembly processes to ensure this and similar build-up problems don't happen again.

The second incident involved an F100-PW-220E-equipped Block 42 F-16DG that was operating as part of a two-ship surface attack tactics training mission. While straight and level at 1800 ft MSL (500 ft AGL) and 500 KIAS, the MP heard an explosion and experienced heavy vibrations. He immediately pulled the throttle to idle and began a zoom climb. His wingman told him he was on fire and the MP ejected successfully. The MA impacted remote, flat desert terrain and was destroyed.

Examination of the wreckage revealed that a bolt securing the 3rd stage turbine airseal to the 3rd stage turbine disk failed. The failure of that bolt overstressed an adjacent bolt, which also failed, resulting in liberation of the 3rd stage turbine airseal into the gas path. The subsequent turbine damage and imbalance liberated hot turbine hardware into the MA's A-1 fuel tank, leading to the inflight fire.

There were no engine-related destroyed aircraft in the F100-PW-200 or F100-PW-229-powered F-16 fleets for FY01.

A bird strike did cause one Class A dollar value mishap in an F100-PW-200-powered F-16B. The MA was part of a two-ship bombing training mission. The aircraft flew through a flock of large birds after the third bombing pass and at least one of them was ingested into the engine. As a result of the bird strike, the engine suffered major distress, including damage to multiple fan and compressor blades, a ruptured fan case and oil tank, and two broken fuel lines. The MP turned toward the nearest recovery field and declared an inflight emergency. Fortunately, the engine continued to operate well enough to allow a safe landing at the recovery airfield.

The MP taxied clear of the runway, stopped and awaited arrival of the fire department. A Maintainer, noticing fuel leaking from the bottom of the aircraft and flash fires developing near the brakes, directed the MP to taxi away from the puddle of fuel. When the MP moved the throttle up, the extensive engine damage caused it to stall and the RPM began to decay. The MP then placed the throttle to cutoff. Fuel draining from the P&D valve, a normal part of the shutdown sequence, was ignited by the hot brakes, which also ignited the fuel leaking from the broken fuel lines. The resultant aircraft fire damage, combined with the bird strike damage to the engine, drove this mishap past the $1 million Class A threshold.

There were no F-15 engine-related destroyed aircraft in the F100-powered fleets this past fiscal year but, like the F-16, there was a Class A dollar-value bird strike. An F100-PW-220-powered F-15E on a surface attack training mission impacted a flock of Lesser Scaups. Flight conditions at the time of the mishap were 650 feet AGL and 450 KIAS. The bird strike caused catastrophic damage to the right engine, resulting in an engine bay fire. The left engine was damaged beyond repair but, similar to the F-16 incident above, continued to run and brought the aircraft home. Additional damage occurred to the right conformal fuel tank, left ramp, navigation pod, targeting pod and left side of the canopy bow.

TF34 Engine-Related Mishap

While not the primary cause of this Class A Mishap, a TF34 engine did play a role in the event. This TF34-GE-100A engine-related mishap involved an A-10 on a close air support mission. The right engine developed an oil system malfunction during flight and was shut down. The oil system malfunction was attributed to an improperly clamped oil pressure transmitter line that cracked due to contact with the closed engine cowling. Currently, there's an aggressive TCTO underway to replace this oil line with a new design that is flexible and

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requires no clamping. Until this TCTO is complete, the field has inspected all TF34 engines to ensure the oil pressure transmitter lines are clamped properly.

FOD Mishaps—They Pretty Much Ate Our Lunch in FY01

Let's take a minute and talk about FOD.

While we addressed it in some depth last year, it's apparent that we didn't do a good enough job getting our word across. It's especially true when you look at a couple of the Class A FOD events from FY01. Events that just don't make good operational or maintenance sense. Both resulted in well over a million dollars damage, and both were totally avoidable. Was it because someone missed an inspection? Or was it because we were just in too much of a hurry to get the job done?

The first event involved an aircraft fastener. This aircraft had just come out of depot and was heading home. A much-needed asset the wing had not seen for eight months was finally returning. After making it home, the inspections began. Lo and behold, extensive damage was discovered on the No. 2 engine's fan, compressor and turbine sections. Man, what a bummer! Aircraft comes home after being gone for eight months and we already have an engine change! Not to mention a $1 million-plus bill to fix the engine damage that was caused by an aircraft fastener that was just left lying around.

Another event took place in the Hush House. It was a Friday—Friday afternoon to be exact. This jet would be the last run of the day. Get this done and we're outta here for the weekend! Everything was going all right until "it" happened. Going from idle to max power, there was a loud bang and the aircraft started to vibrate. That's when the ground observer realized the end of his ground cord had detached from the aircraft and was in the engine inlet. Inspection revealed the engine had ingested the metal cannon plug connector and about six feet of cord, causing severe damage to the fan and compressor sections. Another $1 million bill for not paying attention to detail.

If you need more proof that FOD prevention needs your attention and involvement, take a look at Figure 5. It shows that engine FOD mishaps in the Class B range—repair costs totaling more than $200,000 but less than $1 million—have been steadily increasing. While there were five engine FOD mishaps in the Class B Mishap category in FY96, there were 38 in FY01—an increase of more than 700 percent!

The ground observer realized the end of his ground cord had detached from the aircraft and was in the engine inlet.

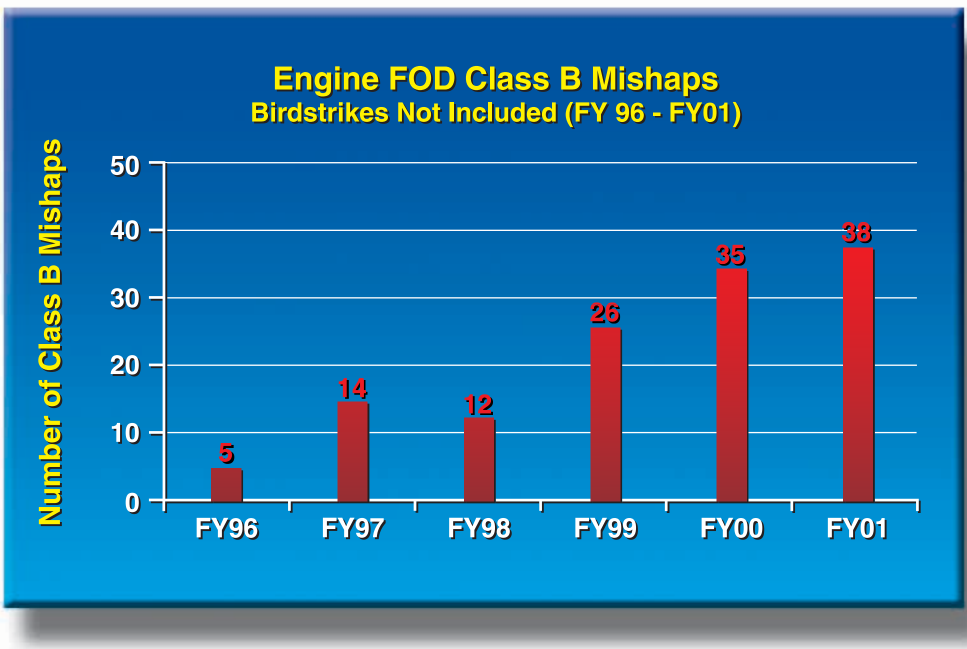

Figure 5

Let's work and strive this coming year to improve our practices and drive the FOD rates back down. Pay attention to details, don't rush and remember to stay vigilant for the unexpected.

USAF Class A Flight Mishaps

FY02 Flight Mishaps (Oct-Nov 01)	FY01 Flight Mishaps (Oct-Nov 00)
3 Class A Mishaps	**4 Class A Mishap**
0 Fatalities	**1 Fatalities**
1 Aircraft Destroyed	**4 Aircraft Destroyed**

14 Oct ♣	An HH-60 crashed into a river while flying a low-level training mission.
17 Oct	An F-16CG was severely damaged following an aborted takeoff.
25 Oct	An F-16C departed the runway after landing.
05 Nov ✶	An F101 engine undergoing Test Cell maintenance sustained severe fire damage.

- A Class A mishap is defined as one where there is loss of life, injury resulting in permanent total disability, destruction of an AF aircraft, and/or property damage/loss exceeding $1 million.
- These Class A mishap descriptions have been sanitized to protect privilege.
- Unless otherwise stated, all crewmembers successfully ejected/egressed from their aircraft.
- Reflects only USAF military fatalities.
- "♣" Denotes a destroyed aircraft.
- "✶" Denotes a Class A mishap that is of the "non-rate producer" variety. Per AFI 91-204 criteria, only those mishaps categorized as "Flight Mishaps" are used in determining overall Flight Mishap Rates. Non-rate producers include the Class A "Flight-Related," "Flight-Unmanned Vehicle," and "Ground" mishaps that are shown here for information purposes.
- Flight and ground safety statistics are updated frequently and may be viewed at the following web address: http://safety.kirtland.af.mil/AFSC/RDBMS/Flight/stats/statspage.html
- **Current as of 03 Dec 01.** ✈

NOTE: The Dec 01 edition of Flying Safety *reported a C-17 sustained Class A Mishap-reportable engine damage during flight on 26 Sep 01. Revised repair cost estimates have resulted in this mishap being downgraded to Class B Mishap status. This reduces the total number of FY01 Class A mishaps from 25 to 24. Here are the revised FY01 Flight Mishap totals:*

(Revised) Final FY01 Flight Mishaps Totals (Oct 00 - Sep 01)

24 Class A Mishaps
6 Fatalities
21 Aircraft Destroyed