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Class of 2004

Year in Review

FSM
FLYING SAFETY MAGAZINE

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contents

Editor's Note:
All mishap rates are per 100,000 flying hours. FY04 flying hours in charts are forecast for September.

Cover: Photo Illustration by Dan Harman
Rear Cover: Illustration by Dan Harman

U.S. AIR FORCE

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MESSAGE FROM THE CHIEF of SAFETY

We are in an extraordinary era for the United States Air Force. We are grappling with a lethal foe intent on causing mortal harm to our nation. We are operating in almost every conceivable environment while managing technology advances, force-shaping issues, and a challenging operations tempo.

We closed FY04 having flown over 2.42 million hours, increasing by 46,000 hours over what we flew last year.

By many measures FY04 was a successful safety year, and every Airman should be proud of our many achievements. The fighter mishap rate was down significantly and we suffered 12 fewer destroyed aircraft than last year. The practices making FY04 a success are something I hope to identify so we as an Air Force can replicate them in the future.

Yet, on the other hand, we lost eight more people than last year. The Air Force suffered several mishaps that simply should not have occurred. This upsets me, and I hope has the same effect on you. We continue to lose our people and destroy our equipment because we failed to follow Air Force directives. Many of our critical procedures are written in blood and by merely following the rules, you can take advantage of the countless lessons captured in Air Force guidance.

This point cannot be overstated: If you identify a hazard, it is your duty to voice your concern to your chain of command. Sometimes this may be difficult because you may be in conflict with your coworkers, supervisor or timeline. Commitment and integrity hold this world-class organization together. Stand up and be counted—you are the difference maker.

Our target is to shorten the time it takes to develop lessons learned from our mishap analysis. The Air Force and the other Services are expending a lot of energy and resources to improve data analysis. From these intense efforts we expect to buy down mishap costs by targeting our most critical safety concerns. Yet, these efforts will go unrewarded, if we as an Air Force fail to use ORM properly. Our objective as an Air Force is not minimum risk—minimum risk could be achieved by simply grounding all our aircraft, no space launches, etc.—but finding a balance. We want to operate with the right risk, not minimum risk.★★

MAJOR GENERAL LEE MCFANN
USAF Chief of Safety

DEPARTMENT OF THE AIR FORCE — THE CHIEF OF SAFETY, USAF

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E-Mail — jerry.rood@kirtland.af.mil
Address Changes — patricia.rideout@kirtland.af.mil

24-hour fax: DSN 246-0931

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F-16

USAF Photo by SSgt Lee O. Tucker

MAJ GREGORY R. NEWMAN
HQ AFSC/SEFF

FY04 was the best year ever for the F-16! In over 25 years, the Viper has not had a year in which there were only two Class A's. To find the most recent year with two or less Class A's you have to go back to CY79. In that year also, there were only two Class A's, but the mishap rate was a whopping 30.64! The other exception to this was CY77 and CY78, when there were zero Class A's. Keep in mind, however, the F-16 was in its infancy, and only 856 and 1,402 hours were flown respectively. Compared to the 368,707 hours flown by the F-16 fleet through 28 Sep 04, it's like comparing apples and oranges. The unfortunate news, however, is we still lost one fellow pilot in one of our two Class A's this year.

To demonstrate just how stellar a year the F-16 had, consider these statistics: In FY03 there were 11 rate-producing Class A mishaps, for a rate of 3.09. By comparison, the two Class A's this FY equate to mishap rate of only 0.56. (Yes, you read that correctly, less than one mishap per 100,000 flight hours.) Even if we were to count the Singaporean F-16 Class A (which occurred at a U.S. base, but does not count toward the USAF mishap rate), the rate would only be 0.81...still an outstanding accomplishment! Again, to give you a general idea of the historical statistics on the F-16, the lifetime mishap rate is 4.14 and the 10-year average is 3.22. Outstanding work and a great year of flying for all involved…from the pilots and maintainers to the Depot folks, engineers, contractors, etc.

Before we celebrate too much, though, one thing to note was that both USAF Class A's and the FMS Class A this year were ops-related. Additionally, most involved human factors of one type or another. Let's have a look at some of the specifics from each mishap and see what we can learn from them.

Class A Mishaps

The following is a summary of this year's Class A mishaps: one midair, one runway departure on landing and one controlled flight into terrain (CFIT). (Of note: the CFIT mishap, while it occurred at a US base, was an FMS aircraft with a foreign pilot on-board and is a non-rate-producing mishap for USAF purposes.)

—F-16C/F-16C Midair. (Taken from the Accident Investigation Report (AIB).) The aircraft were part of a local daytime 4 v 2 Offensive Counter Air (OCA) sortie to be followed by a Basic Surface Attack mission. While completing a four-ship tactical 180-degree turn prior to commencing the second Offensive Counter Air scenario, Aircraft 2 struck the formation lead, Aircraft 1. Pilot 1 suffered fatal injuries as a result of the collision. Pilot 2 ejected safely.

Based on post-accident analysis, there is clear and convincing evidence that the right external fuel tank and right lower strake of A2 impacted the cockpit and radome area of A1. The collision shattered the canopy of A1, fatally injuring P1 and ruptured A2's right external fuel tank, igniting and destroying both aircraft.

There is clear evidence the collision was caused by P2's momentary loss of situational awareness while he was conducting an on-board weapons inventory state check, as requested by P1 approximately halfway through the 180-degree turn. During this check, P1 failed to maintain flight contract parameters, descending and reducing his airspeed, which contributed to the mishap. Analyses of multiple data sources indicate that, following the weapons check, P2 acquired Aircraft 3 as lead (thinking this aircraft was A1). P2 did not realize he had lost track of A1 since he perceived A3 as A1. P2 then completed the remainder of the turn based on A3, resulting in the mid-air collision with A1.

—F-16C Runway Departure. The mission was planned as a two-ship night mission. Premission planning, takeoff, departure, mission execution and recovery, through touchdown, were uneventful.

After touchdown and completion of aero-brake, when the pilot lowered the nose to the runway, he experienced a hard right pull (no perceived left brake). The pilot released and then reapplied brakes with the same result. The pilot never dropped the hook because, as he reached for the hook switch, the aircraft crossed the last remaining cable.

Having missed the cable, the pilot began the brake failure procedures, but discontinued any brake analysis when it became apparent the aircraft was going to depart the prepared surface. The pilot elected to stay with the aircraft, versus ejecting, since he felt he was at a reasonable speed and he shut down the engine as the aircraft approached the edge of the runway.

The aircraft continued to veer right, departed the right side of the runway 320 feet from the departure end, and rolled an additional 723 feet until it impacted a four-foot-square concrete encased manhole cover. The impact collapsed the right main and nose landing gear, and the aircraft came to rest on the LITENING II AT Targeting Pod and the station-mounted GBU-12. After the aircraft came to a rest, the pilot successfully performed a ground egress and was uninjured.

—F-16CJ CFIT (RSAF). (Taken from the Accident Investigation Report (AIB).) On 19 May 2004, the pilot of an F-16 aircraft was killed when the aircraft he was flying impacted the ground in Arizona. The Republic of Singapore Air Force pilot and aircraft were stationed at Luke AFB. The aircraft crashed onto the Tohono O'Odham Nation away from any man-made structures with incidental damage to the immediate terrain and vegetation. No other injuries or death resulted.

The mishap aircraft was on a night opposed surface attack tactics mission with a flight of three F-16 aircraft. The mishap occurred on the second engagement between the three aircraft when the mishap aircraft executed a maneuver from approximately 14,000 feet MSL, that resulted in the mishap aircraft impacting the ground in a nearly vertical dive. There was no attempt by the mishap pilot to eject.

The mishap cause was either G-induced loss of consciousness or spatial disorientation. No contributing factors were found with the condition of the aircraft, supervision, flight leadership, training, or health of the mishap pilot.

Class B Mishaps

The F-16 fleet experienced a total of 12 Class B mishaps ($200,000 to $1 million) in FY04, but I will only comment on one (most of the others are not flight or flight-related).

—F-16CJ / F-16CJ Midair. (Taken from the Accident Investigation Report (AIB).) The two aircraft were flying as part of a four-ship air-to-air "fini-flight." The relevant mission profile called for a one-versus-one basic fighter maneuver (BFM) scenario within an altitude range of between 21,000 and 29,000 feet. After a winner is declared from that engagement, the loser departs the area and one of the other two aircraft enters the fight from above 30,000 feet in order to attack the "declared winner."

USAF Photo by SSgt Quinton T. Burris

While performing a nearly pure vertical conversion entry, Aircraft 2 (A2) descended toward Aircraft 1 (A1) from 32,000 feet. As P2 (Pilot 2) prepared to employ a simulated gun attack against A1, P1 executed a defensive break turn. As A1 slowed during the defensive break, P2 was unable to control his closure and the forward fuselage, canopy and tail of A2 hit the aft tail section of A1. Both aircraft, however, safely returned to base.

The primary cause of this midair was P2's failure to recognize and control his closure. Improper task prioritization and channelized attention led to a failure to control closure while attempting to "gun" A1.

Lessons Learned

The question continually asked of me this year has been, "Why is the F-16 fleet doing so well this year? What are we doing differently this year?" My answer has oftentimes been, "I don't know…maybe a bit of luck?"

To start with, the fact that the Viper community didn't experience a single flight-related engine Class A is remarkable, to say the very least. That doesn't mean that we didn't have any engine-related problems…we did, just that none of them resulted in a Class A. Historically, as the only single-engine fighter in the Air Force, we can usually count on at least a couple of engine-related Class A's each year. So, what's behind the dramatic decrease in the F-16 mishap rate? In my opinion, it's due to strong, proactive engine programs, sound decision making (ORM) at the lowest levels, actively involved MAJCOMs, the ability to get lessons learned to the field, and, without a doubt, a bit of luck, too.

My thoughts on the midairs (two this year) are that we're still not setting the proper priorities, continuously, as a community. Our Class B midair could have easily been a Class A with destroyed aircraft and/or fatalities, but we got very lucky. That won't always be the case. As modern fighters continue to get more and more "eye candy" installed in the cockpit, we must train and be disciplined to "aviate, navigate, and communicate." When those things don't happen, in that order, the potential for a mishap increases. To quote what I wrote on midairs in last year's F-16 article:

"Every midair (read that again!) occurred between aircraft in the same element! If a "common thread" could be drawn between these mishaps it would be task misprioritization and channelized attention. These two factors were specifically cited in both accidents. Additionally, a breakdown in basic formation responsibilities seems to be an underlying thread in each of these mishaps. Remember back to UPT… AVIATE, NAVIGATE, AND COMMUNICATE! If you're doing anything else, before that first task is "in the bag," you're wrong. Targeting and sorting with your skull in the radar is great, but you must stay visual and stay in the briefed formation position first! (Remember V.F.R. = visual, formation, radar) Going "blind" and not immediately calling it, taking actions to lag away from the last known position of your flight member, etc., are all critical to effective and safe training."

On CFITs, the ground still has a Pk approaching zero. Although we didn't have a CFIT in the USAF F-16 community this FY, the Royal Singaporean AF did. Unfortunately, their pilot didn't make it out of the aircraft. As the fighter community continues to train more and more in the nighttime environment, we need to use the capabilities of the Viper wisely. Set ALOW, CARA and PGCAS altitude warnings that make sense. Brief and then debrief any altitude deviations and never assume your buddy is aware of where the floor is. The enemy still isn't doing as good a job as we ourselves are when it comes to destroying aircraft and killing pilots.

Finally, continue to practice and hone your skills for any engine-related problem. Know where your emergency and alternate divert fields are located at all times along your route of flight. Practice in the simulator to drive home the procedures for the different engine malfunctions that can occur…so when it happens (and it will) your actions are second nature.

FY04 was the best ever for the F-16, but it doesn't have to stop there. As a community we can continue to "do our business" smartly, tactically, and safely. Sound tactics and safety do not have to be mutually exclusive terms. With a continued emphasis on "Fighter Pilot 101" we can enjoy another year that's even better than the one we just finished!

Check 6! Vipers Rule!

F-16

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	2	0.56	6	1.68	2	0.56	1	1	356,173
5 YR AVG	8.4	2.39	5.6	1.59	7.8	2.21	2.2	2.6	352,167.4
10 YR AVG	10.3	2.86	3.8	1.06	9.4	2.61	2.0	2.4	360,134.1
LIFETIME CY75-FY04	307	3.97	63	0.81	289	3.74	78	115	7,731,686

Airlifters

USAF Photo

LT COL JON TAYLOR
HQ AFSC/SEFF

The global presence of the airlift community constantly places our operators in challenging situations. As one of the greatest force multipliers in the DoD, airlift is constantly called upon to deliver, executing a demanding mission during all hours, in all environmental conditions, and at all points around the globe. To meet the needs of our nation as we wage this war against terrorism, we we must accept and operate with increased risks, placing us in constant jeopardy of leaning too far forward.

The airlift community experienced 47 reportable Class A, B and C mishaps in FY04, down five from the year before. My fear is we have become too comfortable with some hazards and are accepting risks without deliberation and allowing avoidable hazards to become part of the daily grind. Our job would be much simpler if hazards were always obvious. But in the current airlift environment, hazards become harder to detect as they assume forms we have operated with in the past. Patiently they bide their time, and as we debate current events they routinely mask risk, diverting our attention to items unrelated to our mission. They delight in this period of sustained high operations tempo; sensing our complacency, they deceitfully call checklists complete and whisper, "No need to look, you know what the book says."

Some of these risks are showing up in mishaps. Tragically, during a C-17 spoiler maintenance procedure (see the maintenance section for further discussion) we did experience one aviation ground operations fatality.

The strategic airlift community experienced six Class A rate-producing mishaps, split evenly between the C-5 and the C-17. In FY03 strategic airlift experienced two Class A mishaps. I will discuss some of the mishaps below.

The first Class A occurred in the AOR. A C-5 experienced abnormal contact with the runway after executing a tactical approach. Naturally, the crew was well into a long duty day when the mishap occurred. The crew had accomplished a transatlantic flight and experienced a prolonged enroute delay. The crew was performing a night heavy-weight landing and coping with challenging environmental conditions during the approach. There were numerous operationally-related issues involved with this mishap, to include: training, cockpit resource management, and airmanship. No one was seriously injured, and the aircraft was returned to service.

The second C-5 mishap illustrates how integral aircraft manufacturers are to our lives. A fan blade installed in the second stage of the mishap engine contained a defect before installation. This defect caused a nick in the blade and over time developed into a crack from fatigue. The blade failed and exited the engine, causing vibrations, sparks, and eventually, fire before it was shut down. The crew diverted and successfully recovered the aircraft.

The third C-5 Class A mishap was the result of water in the main landing gear's forward rotary actuator that froze at altitude. The gear failed to extend normally, and after applying tech order pro-

cedures, the gear extended on short final in warmer air. The tech order procedures contributed to the mishap because there is no guidance when emergency extension is not successful. Ultimately, the main gear extended, but couldn't rotate forward because the R-A MLG Control circuit breaker was pulled as a part of tech order procedures.

Of the C-17 Class A mishaps, two were from engine damage. The first occurred from a spalled ball bearing in the No. 1 engine. Eventually, the bearing cage wore down and broke up, causing vibrations and a turbine shift, in the lateral and forward axial directions. The crew shut down the offending engine and recovered the aircraft.

The second C-17 Class A mishap was the result of the 10th stage stator in the No. 3 engine. The failure was due to fatigue causing metal on metal contact. During refueling, the crew was notified by the boom operator of sparks coming from the engine. While diverting to another base, the engine experienced a catastrophic failure. The crew executed an engine-out approach and landed uneventfully.

For FY04 the C-141B did not experience a single Class A mishap; however, the Starlifter had one Class B mishap, five Class C mishaps, and a total of only ten Class E events.

The C-21 community had a very good year in regards to safety. No Class A or Class B mishaps, and only five Class C mishaps were reported. Three of the five Class C incidents involved engine damage from various causes, including ice ingestion, loss of oil pressure due to a faulty cap, and turbine blade damage due to a liberated stator vane. The C-21 had a high number of Class E events (38) spread across all categories.

The C-9 communities had an exceptional year with no Class A's and only one Class B mishap. The Class B was the result of FOD. The C-9 had no Class C mishaps and only four Class E events.

The C-12 and C-20 communities had an unbelievable year with no Class A, B or C mishaps. As for Class E events, the C-12 experienced only four and the C-20 only two. Hopefully, this stellar safety performance will continue.

FOD once again took a toll. FOD mishaps remained steady from last year at five (one Class A, one Class B and three Class Cs) and affected the C-17, C-5, C-141, C-9 and C-21 communities. The Class A occurred to a highly experienced C-17 crew on a routine ferry flight transiting an army airfield. After simultaneous radio transmissions the crew exited the runway onto a taxiway unintended by tower. The crew was then advised their taxiway was not approved for C-17 operations. The crew elected to reverse taxi and ingested FOD. There were several tower, airfield and OPS-related issues associated with the mishap. FOD damage is a constant risk and it must be evaluated at all phases of aircraft operations. Keep FOD in your crosscheck, and take necessary measures to eliminate it.

Wildlife mishaps are another area continuing to impact airlift operations. In one mishap, a flock of snow geese took on a C-5 and lost, but not before causing Class B damage and forcing replacement of the No. 3 engine and several flaps. While in another mishap, a couple of deer crossed a runway, and one was struck by a C-21 during landing roll, causing Class C mishap damage. Ensure you are following your BASH procedures, as this is often your best countermeasure to an ever-present environmental risk.

Through it all we were fortunate not to have experienced greater fatalities or destroyed an aircraft, and the principal reason we were able to avoid this eventuality is the professionalism of our people. Obviously, we are in constant peril of being tangled in a mishap chain. Avoid becoming part of next year's statistics. Stay alert and look out for one another.

USAF Photo

USAF Photo

C-5

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	0	0.00	1	0.97	0	0.00	0	0	103,384
5 YR AVG	0.2	0.24	2.4	2.90	0.0	0.00	0.0	0.0	82,679.0
10 YR AVG	0.2	0.27	1.4	1.92	0.0	0.00	0.0	0.0	73,011.6
LIFETIME CY68-FY04	17	0.78	49	2.24	4	0.18	5	168	2,192,318

C-17

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	3	1.85	3	1.85	0	0.00	0	0	161,790
5 YR AVG	1.2	1.05	5.2	4.55	0.0	0.00	0.0	0.0	114,199.8
10 YR AVG	0.9	1.23	2.8	3.83	0.0	0.00	0.0	0.0	73,080.3
LIFETIME FY91-FY04	9	1.22	28	3.80	0	0.00	0	0	737,056

C-141

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	0	0.00	0	0.00	0	0.00	0	0	45,741
5 YR AVG	0.0	0.00	2.2	4.32	0.0	0.00	0.0	0.0	50,932.2
10 YR AVG	0.2	0.23	1.3	1.49	0.1	0.11	0.3	0.9	87,098.5
LIFETIME CY64-FY04	34	0.32	42	0.39	15	0.14	35	161	10,649,161

C-130

USMC Photo by SrA Lakisha Croley

MAJ CHRISTOPHER P. FROESCHNER
HQ AFSC/SEFF

The C-130 had a single Class A mishap this year that, thankfully, caused no injuries or fatalities. In the past year, the C-130 experienced seven Class B mishaps, above our five-year average of 10 per year and well above the 10-year average of 5.3 Class Bs per year. Of the Class B mishaps, two were due to first-stage turbine blade failure, two were due to high winds causing rudder and tail damage to parked aircraft (non-rate producing), and one was due to damage caused by bird strikes. The remaining were single occurrences that included departure from a prepared surface during an assault landing, inflight fire damage to a wing, compressor failure, and a reduction gear box failure. There were 128 total Class C mishaps, including FOD damage, a collapsed nose gear during a ski takeoff, an uncommanded firing of a 25 mm gun, inflight shutdowns due to engine generator failures, prop damage due to rocks and gravel on a landing zone, first stage turbine blade failures, and flights into thunderstorms, lightning, wind shear and hail.

The Herc community did an outstanding job of reporting Class E mishaps, as we had 1,069 total Class Es reported (that's almost two per aircraft we have!). By far, the greatest culprit was propulsion events, as we reported 805 events under this category. Of note were endemic problems with prop and engine valve housing assemblies, oil cooler, float switch and filter problems, and fluid pressure fluctuations. A total of 23 Class Es were flight control-related, including rudder and aileron trim malfunctions, uncommanded flight control inputs, failed trim motors and a bad flap drive motor. Twenty-six HAPs were filed this past fiscal year, to include parachute material lodged in the flight controls following an airdrop, uncommanded rudder inputs due to loose armor plating, a four-engine rollback during propeller re-indexing (ever heard that one before? Yikes!), and an inadvertent engine shutdown due to contact of NVGs.

During the year, you filed 76 HATRs, with many of them involving hazardous air traffic out in the CENTCOM AOR. The good news is that many of these have been acted upon to improve the flying environment out there. A total of 127 Class Es were reported under the miscellaneous heading, most of which involved smoke and fumes elimination. Three more notable events included a dual ADI failure, a dual ADI and dual HSI failure, and a dual mission computer failure. Rounding out the numbers, we had 26 physiological incidents in the C-130 community, including an oxygen bottle that came loose and struck a crew member and a rapid depressurization, along with the standard ear and sinus blocks. With that wrap-up of the numbers, I would like to draw attention to notable mishaps that provide us some important lessons to share with the community.

C-130 Class A Mishap

The single Class A mishap for the C-130 community this year took place during a local proficiency sortie. After an uneventful touch-and-go, the crew attempted to raise the gear using the gear handle. After normal transit time, one of the main landing gear and the nose gear indicated up and locked, but the other main landing gear signaled in-transit indications. After the gear was lowered, the aft main landing gear was partially extended and the forward main landing gear was almost fully extended. Alternate gear operations were attempted to lower the main landing gear without any improvement in condition. After running several checklists and attempting to use G-forces to lower the gear to full extension, manual extension was used to extend the main landing gear. Full extension was confirmed visually, but the gear was not secured with emergency tie-down fixtures or chains. Following touchdown the gear collapsed, and an engine propeller, wingtip, tailskid, antennae, and the aft portion of the fuselage contacted the runway. The aircraft veered to the right but remained on the runway. One of the propellers separated from the engine and sent prop blades and large amounts of shrapnel through the aircraft skin and into the cargo compartment. The extensive damage easily reached the Class A threshold, but thankfully no one was injured in the mishap as the Loadmaster was on the flight deck for the landing.

C-130 Class B Mishap—Multiple Bird Strikes

A crew was performing multiple touch-and-go's to an airport when it struck over 70 birds that had flushed from the airfield grass. The crew was able to react to the bird strike in time to keep the aircraft on the ground and brought the aircraft to a stop. This situation provides an excellent learning point for everyone who has ever been in the pattern for "endless" approaches. Even if a bird condition is tagged as low, it is important to keep vigilant watch for birds around the airfield and approach patterns, and if something does not seem right (i.e., you saw several birds around the runway on that last approach), you may want to seriously reconsider whether another half dozen approaches and/or landings to that same runway is the most prudent decision. Work with tower, the SOF (if you have one), or even the airfield manager to have someone drive out and re-check the airfield environment prior to continuing approach work at that field. Also, plan an alternate airfield for approach work in case a problem arises at the primary airfield.

C-130 Class B and C Mishaps—Dash-7 First Stage Turbine Failures

There were several examples of first stage turbine blade failure to Dash-7 engines recorded this year, and most of them read the same. In fact, this condition has occurred over 40 times in the past three years, with two Class Bs and 10 Class Cs this year alone. This is an improvement over last year's numbers due mostly to the fact that over half the fleet has had the problem corrected through the fix described below. The signature footprint of this incident involves the aircraft shaking, which is shortly followed by a loud bang. In some instances, an abrupt yaw is felt as the engine loses its thrust. Engine RPM typically rises and then drops. Oftentimes, a generator out light, engine oil pressure going to zero, and a decreasing Turbine Inlet Temperature (TIT) follows this. The crew shuts the engine down and returns to base, where it is determined that a first stage turbine blade has failed, initiating the mishap sequence. Thankfully, the mighty Hercules has four fans of freedom, and losing one of them is not a catastrophic event.

It is a well-known and established fact that first stage turbine blades on T56-A-7 engines currently in service are prone to stress rupture prior to their designated life cycle limits as a result of high cycle fatigue. The shroud at the tip of the first stage blades has multiplied these physical stresses. The shroud has been redesigned into a "Z" shroud that alleviates the high frequency vibration seen with the previous design. The redesigned blades were available for field installation in March 2002, and of the 1,370 T-56-A-7s in inventory, 904 (66 percent of the fleet) have been retrofitted with the new "Z" shroud to date. The estimated completion date for the fleet-wide refit is in the 3rd quarter of FY06.

C-130 Class B and C Mishaps—Dash-15 First Stage Turbine Failures

We had one class B and one Class C mishap this year that involved failures of the first stage turbine on Dash-15 engines. In addition to fir tree problems (see last year's article), this type of failure is a well-documented problem in the T-56-A-15 engine. Midspan failures are known to occur by a stress rupture due to material limitations of the IN738 alloy used in the blades. Failures are caused by a combination of engine operating time and high operating temperatures. A historic search of Class C or higher mishaps revealed only two other in-flight failures of first stage turbine blades in -15 engines; however, one air base reports over 20 engine changes to -15 model engines over the last two years for burnt or missing blades on -15 engines. There are two fixes in place for this problem. New thermocouples are in test phase of development, and they are expected to double or triple the flight hours of old thermocouples. Additionally, a new first stage turbine blade is replacing old ones with a platinum-alumnide external coating and an internal CVD alumnide coating that provides more than 7X stress rupture resistance and 2X corrosion resistance over the current turbine blades. Replacements are being made at depot-level maintenance as turbines require overhaul. This process began in March 2002, and it is not projected for fleet-wide completion until 2012.

The C-130J

The new kid on the block had another fairly successful year with only one Class B mishap and three Class C mishaps. There were 21 total reported Class E events, including an inflight uncommanded opening of the aircraft cargo ramp, several wildlife strikes, three cases of propeller low pitch stop failures, a hydraulic pump failure, and one instance of an engine generator failure. I applaud the community's increased reporting efforts, as they have resulted in increased community awareness of trends, especially in the cases of the propeller low pitch stop failures. These trends are noted by the SPO and Air Logistics Centers and acted upon when trends are noticed.

A C-130J suffered Class B damage to the rudder when winds gusting to 30 knots caused a rudder output lever assembly to snap in two. This is one of two instances of damage to parked C-130s caused by high winds, often as low as gusts to 30 knots. These two instances alone cost the US Air Force over $1.2 million. The tail of a Herc acts as a huge weather vane in these instances, and damage can occur if the aircraft is not parked into the wind or prepared for high wind situations.

Detailing the three Class C mishaps: An engine scavenge pump separated from a generator while the C-130J was in flight, and this caused an unisolated bleed air leak in the engine nacelle and some collateral damage to the cowling and engine brackets. The generator manufacturer was aware of the particular mode of generator failure, a fix is known, and procedures have been put in place to modify the existing pump fleet-wide. Second, a J model had a hung load during airdrop testing of the electronic cargo handling system. During a CDS airdrop, the extraction chute deployed and began pulling the load out, but engaged locks downstream in the cargo compartment stopped the load. The mishap pointed out an error in the airdrop checklists, and fixes to this error are in the works. Finally, another C-130J was at cruise when a generator control unit failed, forcing the crew to shut down the engine.

Note to AFSAS users: In order to find all C-130J mishaps, you need to search under the aircraft headings of C130J, CC130J (the stretch models), and WC130J to find all the particular J models out there. I learned this one the hard way, and thought I would pass it on.

There are no new mishaps out there, only repeats of the lessons we have learned in the past.

Conclusion

While I applaud the outstanding work of the Herc community and its accomplishments in the field, lessons learned from the past continue to be the lessons we re-learn on a daily basis. We need to carry the knowledge gained from previous mishaps and events with us as we take to the skies each and every day. Remember, there are no new mishaps out there, only repeats of the lessons we have learned in the past. When flying AOR or contingency missions, an increase in the acceptable level of risk is a given. That said, we need to ensure to guard against the mindset that "no risk is too great" to successfully complete a high priority mission. While this mindset did not directly bite the C-130 community this year, the Air Force continues to suffer fatalities resulting from this mindset.

USMC Photo by Cpl Jose Anthony Rubio

Contingency missions require high levels of risk management and constant assessment and reassessment of mission risks, both on the ground and in the air. Real world missions result in high levels of mission press. We need to make sure high levels of planning, adherence to procedures, and en route decisions that err to the side of safety go with those missions. That same level of care needs to be taken with us to the routine missions as well. Realize that, in some instances, equipment may not always give us the advisories we expect. We need to keep focused on what is going on inside and outside the aircraft and watch for that traffic out there, not always expecting our systems to provide perfect situational awareness. Controllers are human and can make mistakes, as is evident by the myriad of NMACs filed, and it is up to us to catch those mistakes and keep ourselves safe.

At the HQ AF Safety Center, we continue to notice a highly remarkable trend of flight into thunderstorms across the entire aviation community. Weather avoidance is not a problem germane to the C-130 world, though we have our fair share of damage from TWX. In this past fiscal year, the AF recorded inflight damage to 27 aircraft from lightning, hail, heavy rain, and turbulence, including one Class A and one Class B mishap. Together, these mishaps have cost the Air Force $4,649,823! That is a 119 percent increase in damage costs from FY03. For C-130s in FY04, five mishaps of flight into thunderstorms resulted in $587,631 in damages, or roughly 13 percent of AF damage costs due to weather. This is an improvement to FY03, when eight reported C-130 mishaps of flight into thunderstorms resulted in $870,530 in damages, or 41 percent of AF damage costs. But on an aircraft with navigators onboard and a good weather radar, we can do better. It is important to stress that the visible thunderstorm cloud is only a portion of a turbulent system whose updrafts and downdrafts can cause severe turbulence up to 20 miles from severe thunderstorms. We need to continue to utilize our available resources, including onboard radar, weather forecasting and air traffic controller weather advisory systems.

I wish you all a safe flying future and Godspeed to your next destinations!

C-130

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	1	0.29	7	2.03	0	0.00	0	0	345,377
5 YR AVG	1.4	0.45	10.0	3.24	0.4	0.13	0.4	3.2	308,730.8
10 YR AVG	1.1	0.37	5.3	1.78	0.6	0.20	0.8	4.4	297,100.8
LIFETIME CY55-FY04	149	0.90	192	1.16	85	0.51	136	629	16,520,821

KC-10

USAF Photo by SSgt Cherie A. Thurlby

MAJ JOEL HARVEAUX
HQ AFSC/SEFF

All in all, we had a good year in the KC-10 community. There was no loss of life or destroyed airframes. We did have one more Class A than last year, but one less Class B. We experienced roughly a 180 percent increase in Class C mishaps, and a 50 percent increase in Class E events. The increase in Class C mishaps wasn't due to FY04 being a particularly bad year, but rather due to FY03 being a particularly good year. The five-year average for Class Cs was 14 per year. Last year only experienced six Class Cs versus the 17 this year.

Taking a slightly different tack this year from last, we'll address the various mishaps and events based on broad typifications of the mishap/event across mishap classes. In this way, we'll lump all engine-related mishaps together, and all air-refueling mishaps together, etc. This will paint a more comprehensive picture of that segment of mishaps, and preclude the need to jump among the mishap classes to find related information.

Engine-Related Mishaps/Incidents

By and large, the engine-related mishaps came from numerous unaligned sources. There are no standout trends or failure modes that kept resurfacing as we went through the year.

Our engine-related mishaps included the two Class A mishaps we experienced this year. The limited number of Class A's and the fact that one is still under investigation make it quite difficult to go into detail here about cause while still maintaining the privileged status of those reports. Please see your local safety office for more details.

The closest thing we had to a trend in engine-related mishaps were the two bird strikes and two FOD incidents that caused varying amounts of damage. From there, our mishaps/events originated from varied sources. Of these mishaps, the following were of particular note: A boost pump was apparently inadvertently shut off, resulting in a flameout. A pressure drain valve failed, resulting in reduction of thrust. An engine rolled back on a go-around due to an anti-siphon valve getting stuck open. Finally, an oil pressure line ruptured, resulting in an engine shut down.

Air Refueling-Related Mishaps/Incidents

The AR-related incidents were pretty equally spread between the wing air refueling pod (WARP), Center-Line Drogue, and boom systems. The WARP system endured two events. In one case, a drogue deployed on takeoff and struck the runway. In another, a failed rewind spring and shroud resulted in a failure to retract the hose.

The center-line drogue system was involved in the most incidents. In three cases, a sine-wave developed that was not mitigated by the reel response system, resulting in removal of the drogue basket. In all three cases, the reel response check was OK, and the receiver was reported to have had a normal rate of closure on contact. In one case, the reel bleed valve shorted, resulting in a failure to retract the hose which was then followed by a failure of the guillotine system. The final incident was caused by a deteriorated hose.

Of our two boom incidents, one that is still under investigation involved a ruddervator that was damaged in flight and broke off the aircraft. The other was an incident where the boom contacted

the receiver outside the receptacle while the receiver closed on the tanker in a turn.

There was one other incident where the aircraft approached a stall following the reel response check. This resulted in wrinkle damage to the skin of the elevator.

Miscellaneous Occurrences

There were several other occurrences of note. On one aircraft, an electrical short in the ground power cart cable burned into the fuel cell wall. The fire extinguished itself before it was discovered. In another case, an anti-ice tube support was installed wrong which allowed it to shift, resulting in damage when the slats were retracted after landing. There was also one instance where an unpurged, but certified, aircraft engine leaked fuel when it was shipped as cargo.

Near Mid-Air Collisions

There were 13 NMACs this year, down from 17 last year. In 10 of the 13 cases, TCAS played a major, if not critical, role in alerting the crews to the impending conflict. Six of the NMACs occurred in one of the AORs. It should be noted that every AOR NMAC occurred in the air-refueling track, and all but one versus a military aircraft.

All other NMACs occurred stateside. Two occurred at Travis AFB, and five occurred at McGuire AFB. The most remarkable of these was a 200-foot pass by two KC-10s in the McGuire pattern. All but one stateside NMAC occurred within 5000 feet AGL.

The bottom line for NMACs is to keep your situational awareness up, don't get too comfortable either while at high altitude or low, and follow your TCAS advisories.

Conclusion

We had a good year with no lost aircraft or fatalities and a roughly stable number of Class A and B mishaps, though we did see a rise to a more traditional number of Class C mishaps. We also saw a decrease in the number of NMACs—though even one is one too many.

The only downside trend to this year has been the continued number of refueling mishaps that mar our performance—especially considering their adverse affect on mission accomplishment.

Taken as a whole, it's been a busy year, and the community can be proud of its accomplishments. But even as we reflect on a good year, there were still too many incidents that could have been prevented and risks that should have been better mitigated. Keep your guard up and let's strive to make FY05 an even better year. Fly Safe!

USAF Photo by SSgt Ricky A. Bloom

KC-10

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	2	3.16	1	1.58	0	0.00	0	0	63,202
5 YR AVG	1.2	1.99	1.8	2.98	0.0	0.00	0.0	0.0	60,408.0
10 YR AVG	0.8	1.46	1.0	1.82	0.0	0.00	0.0	0.0	54,942.2
LIFETIME CY81-FY04	10	0.96	15	1.44	0	0.00	0.0	0.0	1,038,874

KC-135

MAJ JOEL HARVEAUX
HQ AFSC/SEFF

All in all, we had a good year in the KC-135 community. There was no loss of life or destroyed airframes. We also had one less Class A than last year, and roughly the same number of Class Bs. We did experience roughly a 70 percent increase in Class C mishaps, and a 55 percent increase in Class E events. Some of these increases can probably be written off to increased reporting via AVSAS, and some to cost increases. Time will tell if the increase is purely chance or a true up-tick in the occurrence of lesser mishaps and incidents.

Taking a slightly different tack this year from last, we'll address the various mishaps and events based on broad typifications of the mishap/event across mishap classes. In this way, we'll lump all engine-related mishaps together, and all air-refueling mishaps together, etc. This will paint a more comprehensive picture of that segment of mishaps, and preclude the need to jump among the mishap classes to find related information.

Engine-Related Mishaps/Events

The one Class A for this FY occurred in a KC-135E model at 1500 feet AGL on departure. Per the AIB report, the crew heard a bang, felt a shudder, and observed flames trailing the engine. They shut down the engine and recovered uneventfully. This mishap occurred due to failure of the 1st stage turbine nozzle support front flange weld. This area had been exposed to prolonged and/or improper heat at some time in its history, which degraded the hardness of the weld. This allowed hot combustion gases to impinge on the low pressure turbine shaft, ultimately causing its failure.

There were two cases of the No. 4 bearing failing. These occurrences resulted in engine shutdown or seizure. Indications to the crews varied from bangs and vibrations to increasing EGT, fluctuating or dropping Fuel Flow, and decaying N1 and N2. The fleet has changed the oil used on these engines to match the Navy and commercial fleets, which have experienced significantly lower No. 4 bearing failure rates. The bearing has also been redesigned and will be replaced over time. There was also one instance of a hydraulic pump failure.

In addition to the more severe mishaps, there were also a number of other less costly events that warrant mentioning. There were 12 oil system leak/malfunctions and 12 cases of starter lights coming on at inappropriate times (have you reviewed your procedures recently?). There were also two airborne flameouts—one due to a cracked fuel flow transmitter and one due to a No. 4 tank-to-engine manifold failure in the closed position. Additionally, two throttle cables failed, resulting in an unresponsive engine and resultant in-flight shutdowns.

Air Refueling Related Mishaps

We had three cases of booms being drug on landing. Two of these were a result of damage to the system and hoist cable in the course of a brute force disconnect. One was the culmination of a troubled six-month maintenance history on the mishap boom (nine boom related write-ups). It was written up for not flying correctly on several occasions, excessive down pressure, difficulties stowing (x 3), etc. This boom was completely re-rigged twice in

USAF Photos TSgt Erik Gudmundson

the six-month period prior to this mishap. Other boom incidents included four brute force disconnects and five of receivers getting too close, all resulting in other boom/system damage.

In many of these incidents, the receiver closed quickly, resulting in ice shield contact or nozzle binding and a brute force disconnect. As far as boom refueling mishaps are concerned, the number one place for improvement is earlier recognition of excessive closure by both the receiver pilot and the boom operator.

There were nine MPRS mishaps. In three instances there was an unexplained sine wave which removed receiver probes and in some cases resulted in loss of the basket. In three other cases, the cause of the damaging sine wave was found (a pod fuel pump failure, a disconnected tensator spring, and a failed tensator drive chain). In one case, the crew was forced to land with the hose in trail.

I'd like to spend a little more time on the final two MPRS mishaps. In the first case, the crew found the basket partially deployed (approx 12 inches) during preflight. After several failed attempts to retract it on the ground, and after consulting with maintenance, the crew elected to take the jet airborne and accomplish the full rewind airborne. The basket and hose deployed on takeoff without any system braking, resulting in loss of the full hose and basket.

In the last case, the mishap occurred at a very busy time for the crew. Multiple non-standard external events during the air refueling combined to hamper the aircraft commander's SA. When queried by the boom operator, he cleared deployment of MPRS approximately 15 knots above the limiting airspeed. Other crew members caught this mistake and told the boom not to do so. However, the congested radios delayed the message reaching the boom until the basket was already in transit. The boom immediately returned the switch to the "rewind" position. Due to pod design, this disengaged the system brake and allowed an unrestrained trailing of the basket, and separation of the hose and basket from the aircraft.

T.O. changes have been submitted on both of these last mishaps to clarify to crews the proper actions in these scenarios.

Flight Control Incidents

There were 10 flight control incidents, four of which were stab-trim related. These stab-trim incidents occurred throughout the flight regime (climbout, air refueling, approach, and touch-and-go). Two were due to failed stab-trim actuators, one to a failed limit switch, and one is undetermined (that aircraft has since been retired). Stab-trim incident mitigation took a huge step forward this year with the testing and approval of a control column actuated brake for the stab-trim system. Kit purchase and installation contracts are currently in the works.

There were also two incidents of spurious autopilot control inputs, one broken spoiler actuator, one case of elevator binding, one uncommanded rudder input, and, finally, one incident where an undiscovered aileron-balance-bay bird nest interfered with controls in flight.

Smoke And Fume Incidents

Smoke and fume events still lead the tally as the most frequent reportable occurrence in the KC-135 community. Of these, our old friend the Air Cycle Machine (ACM) was to blame in 24 out of 39 cases. In nine of these cases ACM bearing failure was cited. In 12 others, just general failure or seizure was cited. There were also two cases of contaminated water socks, and one overheat. The fix for many of these failures has been tested and approved. The new ceramic bearing kits are in the works and will start appearing on an attrition basis in the spring of 2005.

The other multi-hit sources for smoke and fume events included the TRs (5), the electronic cooling cabinet (3), and hydraulic/bleed air check valves (2). In these last two cases, these valves were actually installed backward. The remaining 15 incidents came from 15 different sources.

Make sure you are doing your part to be up on procedures, use the T.O.

USAF Photo by SrA Stacia M. Willis

Lightning Strikes

One disturbing trend we saw this year was lightning strikes. We saw a 260 percent increase in reportable lightning strikes this year—up to eight from three last year. They were evenly split between stateside and overseas occurrences, and all of them caused Class C damage (in half the cases taking out the weather radar). In every case the crews were observing the appropriate separation from thunderstorms. We must remember, as AFH 11-203, Vol.1 states, there are five conditions that are favorable to an aircraft being struck by lightning, and not one of them is the presence of thunderstorms. The five conditions are being:

(1) within 8° C of the freezing level;
(2) within 5000 feet of the freezing level;
(3) in light precipitation;
(4) in clouds; or
(5) in negligible/light turbulence.

So, do your best to avoid or minimize your time in these conditions (OK—except maybe for the negligible/light turbulence).

Conclusion

Taken as a whole, we had a good year with no fatalities, and only one Class A, despite the varied and numerous failures and incidents that raised their head this year. As this year shows, you can expect anything from an engine failure to a lightning strike, a brute force disconnect or MPRS problem to smoke and fumes on any given sortie. As an operator, once you've completed thorough mission planning and pre-flights, there is little you can do to control what potential mishap you may face. What you can do is make sure you are well prepared for what the flying gods can throw at you each day. Know your books, and be ready to fly both, mentally and physically. As a maintainer, you can be one of the strongest allies in the fight to keep the flying gods in check. On the flip side, you can also be an instrument of the flying gods in precipitating an incident or mishap. Make sure you are doing your part to be up on procedures, use the T.O., and do the job by the book. It really is a team effort, and this year we did pretty well. Let's keep our guard up and have another good year!

KC-135

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	1	0.41	8	3.25	0	0.00	0	0	246,225
5 YR AVG	0.4	0.18	4.8	2.20	0.0	0.00	0.0	0.0	218,423.6
10 YR AVG	0.4	0.19	2.8	1.30	0.1	0.05	0.2	0.4	215,816.0
LIFETIME CY57-FY04	81	0.63	143	1.11	64	0.50	134	629	12,848,121

Surveillance / RECCE

MAJ JEFF RITCHIE
HQ AFSC/SEFF

USAF Photos TSgt Erik Gudmundson

E-3

The E-3 AWACS (Airborne Warning and Control System) community had zero Class A or B mishaps in FY04. Outstanding! For the year, the AWACS experienced three Class C mishaps and 34 Class E events.

Class C

- During takeoff roll, a Franklin Gull was ingested into the No. 4 engine, causing a compressor stall, and the aircraft yawed significantly to the right. Decision speed for the takeoff was 133 knots and the pilot executed the abort boldface at 120 knots. The aircraft was stopped on the runway and experienced hot brakes. Maintenance replaced all eight brake assemblies and tires.
- During the post-flight inspection, maintenance discovered the compressor duct/spacer behind the inlet guide vane case on the No. 4 engine had several cracks and dents. Further inspections revealed damage to the first stage fan disk. This mishap was caused by a balance weight that came loose from the fan disk during flight.
- During the post-flight inspection, maintenance discovered FOD damage to the No. 1 engine. Five first stage fan blades and one ninth stage fan blade were damaged. The damage was caused by a nose dome rivet that came loose during flight.

Class E

There were several system/component failures reported as Class E events. Quite a few resulted in smoke and/or fumes in the aircraft. Of the 22 smoke and/or fumes events, seven were attributed to electrical wiring or equipment, three were caused by aft forced air fans, two were attributed to aircraft batteries, two were caused by primary power feeder duct fans and one was the result of a failed gasper fan. In seven smoke and/or fume events the cause couldn't be determined and the aircraft flew subsequent sorties without incident.

Other Class E reported events include six engine shutdowns due to various non-trending oil system malfunctions, six Hazardous Air Traffic Reports (HATR), three physiological events and one engine flameout due to a ruptured fuel cooler line.

E-3

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	0	0.00	0	0.00	0	0.0	0	0	24,876
5 YR AVG	0.0	0.00	0.4	1.71	0.0	0.00	0.0	0.0	23,365.6
10 YR AVG	0.1	0.43	0.3	1.30	0.1	0.43	0.2	2.4	23,034.4
LIFETIME CY77-FY04	1	0.15	5	0.77	1	0.15	2	24	651,234

USAF Photo

E-4

The E-4 National Airborne Operations Center (NAOC) community had one Class A mishap, two Class B mishaps and three Class C mishaps this year. There weren't any Class E events for the E-4 this year.

Class A

Nine minutes after takeoff, the engine vibration monitor began to show excessive readings. The crew shut down the engine and the mission commander aborted the mission. A tear-down of the engine revealed that a cracked turbine blade liberated and set off a chain reaction, causing damage to the high pressure turbine and low pressure turbine, and vibration damage throughout the engine.

Class B

- The aircraft struck a flock of Snow Geese during the aircraft's practice approaches at an out base. The crew returned to home base and full-stopped uneventfully. The aircraft suffered damage to the radome, leading edge flaps and No. 2 engine.
- An aircraft was undergoing a phase inspection, and damage was discovered on multiple blades in various stages of the high pressure compressor. Follow-up testing is still being accomplished.

Class C

- A sprinkler system in a maintenance hangar activated and dumped approximately 10,000 gallons of water onto the aircraft. Water entered through the aircraft's open hatches and pooled into many areas of the interior. Damage was caused to the carpet padding and the Red and Black Box Assembly. Facilities Plant Engineering and Fire Protection Engineering recommended replacement of several sprinkler system components after investigation revealed many discrepancies.
- A partial flap full-stop landing using auto brakes was performed. During the landing, the auto brakes were overrode with manual brakes. The aircraft was stopped at a taxiway with 1000 feet of runway remaining. Hot brakes resulted, destroying six tires and four brakes.
- An aircraft was damaged beyond flyable conditions when a storm with 1.25-inch hail hit the flightline. Base personnel received a one-minute warning of the impending storm.

E-4

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	1	69.01	2	138.03	0	0.00	0	0	1,449
5 YR AVG	0.4	26.42	0.8	52.84	0.0	0.00	0.0	0.0	1,514.0
10 YR AVG	0.3	20.53	0.5	34.22	0.0	0.00	0.0	0.0	1,461.1
LIFETIME CY75-FY04	4	8.15	7	14.27	0	0.00	0	0	49,065

USAF Photo TSgt John Lasky

E-8

The E-8 Joint Surveillance and Target Attack Radar System (JSTARS) operated another year without a Class A or Class B mishap. Way to go! The rest of the community's mishaps and events include one Class C and eight Class Es.

Class C

On landing rollout, a lock nut from the No. 4 actuator/blocker door connection came loose and was ingested by the engine. It damaged numerous blades and punctured the outboard flap access bay panel near the engine exhaust.

Class E

There were seven engine shutdowns. Five were due to various non-trending oil system problems and two were caused by false fire lights (pinched wires). The Other Class E event was a HATR.

E-8

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	0	0.00	0	0.00	0	0.00	0	0	9,052
5 YR AVG	0.2	2.82	0.2	2.82	0.0	0.00	0.0	0.0	7,082.8
10 YR AVG	0.1	2.31	0.1	2.31	0.0	0.00	0.0	0.0	4,323.7
LIFETIME FY91-FY04	1	2.19	1	2.19	0	0.00	0	0	45,603

USAF Photo

RC-135

The RC-135 community experienced two Class B and two Class C mishaps this year. They also had two Class E events.

Class B

• An aircraft experienced a No. 2 engine overheat without fire indications during ground operations, and the crew shut it down. The ninth stage High Pressure Compressor (HPC) bleed air valve controller failed. Damage was done to numerous engine components. The investigation revealed many problems with multiple processes that contributed to this mishap.

• It was déjà vu when just over two months later a second aircraft experienced an engine overheat without fire indications. A failure of the ninth stage HPC bleed air valve controller on the No. 3 engine caused even more damage than the first incident. Just like the previous incident, the investigation identified numerous problems with processes that led to this mishap.

Class C

• The acoustical panels on all four engines were damaged when an aircraft encountered unforecasted icing conditions the anti-icing equipment couldn't handle. The icing conditions weren't forecast and the crew applied all appropriate anti-icing measures in accordance with their directives.

• Two aircraft were damaged beyond flyable conditions when a storm with 1.25-inch hail hit the flightline. Base personnel received a one-minute warning of the impending storm. (See E-4 above.)

Class E

The two Class E events were smoke and/or fumes incidents. One was caused by a faulty temperature controller and the other happened when an Air Cycle Machine (ACM) shaft sheared.

RC-135

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	1	0.41	8	3.25	0	0.00	0	0	246,225
5 YR AVG	0.4	0.18	4.8	2.20	0.0	0.00	0.0	0.0	218,423.6
10 YR AVG	0.4	0.19	2.8	1.30	0.1	0.05	0.2	0.4	215,816.0
LIFETIME CY57-FY04	81	0.63	143	1.11	64	0.50	134	629	12,848,121

USAF Photo by TSgt Erik Gudmundson

U-2

The U-2 experienced one Class B and three Class C mishaps this year. In addition, the community also had three Class E events.

Class B

An aircraft equipment bay sustained substantial heat and smoke damage from a melted terminal post during ground operations.

Class C

• Upon post-flight inspection, maintenance discovered a single screw was missing from the inside of the right intake lip which resulted in foreign object damage (FOD) to the engine. The right intake lip was installed improperly.

• An aircraft's radome and antenna were damaged during a towing mishap.

• Two inertial navigation units (INU) were damaged during aircraft ground operations. A faulty ground power cable was the culprit in this mishap.

Class E

There were two Class E events for the year. One was a physiological incident where the pilot suffered mild decompression sickness, and the other was HATR.

U-2

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	0	0.00	0	0.00	0	0.00	0	0	13,479
5 YR AVG	0.4	3.17	0.0	0.00	0.2	1.58	0.0	0.0	12,621.0
10 YR AVG	0.8	6.07	0.0	0.00	0.3	2.28	0.2	0.3	13,181.7
LIFETIME CY63-FY04	29	6.60	1	0.23	21	4.78	7	12	439,569

Bombers

USAF Photo by MSgt Robert W. Valenca

LT COL MARK E. NUNN
HQ AFSC/SEFF

This year the bomber community experienced a single Class A mishap in the B-1B, luckily without loss of life or injury to aircrew members. Unfortunately, the B-1B logged five more Class Bs, 13 more Class Cs, and 49 additional Class E events than in FY03. The B-2 remained on pace with last year's excellent safety record, logging only four Class C and four Class E events. B-52s also saw a marked increase in mishaps for FY04 when compared to the previous year. They logged four more Class Bs, 15 more Class Cs, and 24 additional Class E events than FY03.

As with FY03 and previous years, engine malfunctions continue to be the bane of the bomber community. The B-1B and B-52 continue to experience large numbers of engine-related mishaps, many of which are attributed to identical malfunctions.

The fact that we continue to see these powerplant-related incidents from year to year indicates a greater need for our operators and maintainers to be cognizant of the trends in these mishaps and work to resolve these issues, or at least mitigate the risks associated with operating these systems with known potential problems.

Obviously, ORM plays a big role here, and understanding the risks by studying our past mishaps is a good place to start.

FY04 B-1B Safety Review

In FY04 the B-1B community did not post a stellar year in regard to aviation safety. The Lancer experienced one Class A, 11 Class B, and 27 Class C mishaps for the year. In addition, a total of 95 Class E events were reported, with 58 of these related to engine malfunctions and/or smoke and fumes in the crew compartment. In fact, this marks the second consecutive year of increased mishaps within the B-1 community, with the majority of these reportable mishaps related to engine malfunctions or engine-related incidents.

Class A Mishap

During landing at an FOL runway in adverse weather, the flight crew attempted a landing during heavy rain showers with unreported standing water on an ungrooved runway. Nineteen minutes prior to the incident, the tower reported crosswinds with gusts to 12 knots and rain showers. The mishap crew elected to fly an ILS approach into the airfield. Heavy rain showers immediately before landing caused strong crosswinds and standing water on the runway, and increased hydroplaning potential. During landing, the copilot failed to adequately maintain crosswind controls, which resulted in the aircraft drifting right of runway centerline. At touchdown, the aircraft immediately began to hydroplane to the right, and subsequently, departed the runway. Debris and mud were ingested into all four engines and caused damage to the

landing gear, wheels and brake assemblies. The copilot eventually regained control of the aircraft and was able to steer the aircraft back onto the runway after traveling 1700 feet through the adjacent grass. Engines No. 2 and 3 were shut down due to caution lights, and the aircraft was taxied clear of the runway and shut down. The crew egressed without injury. Investigation revealed that this runway had a history of hydroplaning incidents due to its ungrooved surface and its coral-based construction during heavy rain showers, but the aircrew was unaware of these factors at the time of the mishap. Additionally, the copilot failed to maintain proper crosswind controls during the final stages of landing. These control errors, coupled with the adverse runway conditions, resulted in the angling hydroplane condition and subsequent runway departure. This incident highlights the importance of proper crosswind control procedures and not "relaxing" the controls during the landing phase, especially during adverse weather and high crosswind conditions. It also stresses the value of good airfield study and understanding of how varying environmental conditions affect runway surface conditions and how they impact aircraft operations.

Class B Mishaps

All 11 Class B mishaps resulted from engine or engine-related malfunctions. Six of the incidents were a direct result of LPT1 fan blade failures, and three mishaps resulted from failed cap screws on the 5th stage flapper valve assembly. In nearly all of the LPT1 failures, engine vibration warning lights were illuminated for a short period of time and the aircrew performed the correct procedure of reducing the throttle for this indication while observing engine instruments. In most cases, the light extinguished when the throttle was reduced, and engine indications normalized. In several cases, a loud bang or thump was noticed prior to the vibration indication and subsequent engine shutdown was required, but in all cases the failure of the blades was associated with LPT1 blade creep failure. In the cases of the 5th stage flapper valve failure, we see a continued trend from FY03 where this same failure was identified in four mishaps. These failures resulted from failed cap screws on the 5th stage flapper assembly that allowed the flapper valves to liberate, causing engine compressor stalls and subsequent engine shutdown. Both of these trend failures are being addressed by the Air Logistics Center in Oklahoma City and include increased inspection cycles and, in the case of the LPT1 fan blade failures, an investigation of better materials for blade manufacturing to decrease the fan blade creep failures in the B-1B engines. The cap screws are also being replaced at regular intervals based on recommendations from several of the mishap investigations. The remaining Class B mishaps included a failure of a bearing locknut, and an engine overheat during initial start due to a hung start.

Class Cs and Class Es

This year the B-1B experienced 28 Class C mishaps. Again, the majority of incidents involve damage to the engines with FOD accounting for eight in-flight incidents and three ground incidents, with an additional three incidents attributed to internal engine failures due to various unrelated reasons. Bird strikes accounted for four in-flight Class Cs. The remaining 10 Class Cs were associated with structural damage incidents due to weather, panel/fitting failures, and one aborted takeoff that led to hot brakes and tire damage. There were 95 Class E events, with 52 attributed to powerplant malfunctions, and six smoke and fumes-related incidents. In-flight bird strikes accounted for the remaining 37 Class E events.

FY04 B-2 Safety Review

The B-2 community continued in its tradition of active risk mitigation and mishap prevention and completed another year without a single Class A or Class B mishap. For FY04, the B-2 community had four Class C mishaps and three notable Class E events that we can all learn from.

Class C Mishaps

- At the conclusion of a test flight, the crew lowered the gear and received an unsafe gear indication. A safe landing was accomplished, but maintenance discovered a main landing gear retract actuator had failed due to stress corrosion cracking. There were no provisions to periodically inspect this part, and the decision was made to carry out fleet-wide inspections for corrosion and cracking in the main landing gear retract actuator to ensure this problem does not result in a future mishap. Inspections will continue on a periodic basis to ensure continued risk mitigation.
- Two separate incidents occurred where a single tile departed the aircraft. The single tile departure drove the mishap cost to Class C territory. Both mishaps occurred due to disbonding of the tile due to an incorrect tile adhesion and inspection procedure. The technical order had two similar repair procedures for tiles that had the same replacement process, but the two processes were applicable to different tiles. Thus, it was easy for the technician to use the wrong process and miss an adhesion verification step. These mishaps made the maintenance community very aware of the situation and allowed for better training to reduce the chances of re-occurrence.
- A B-2 had a hung weapon following a bomb run that included live weapons. Some time after the weapons bay doors closed, the hung store fell

from its rack and impacted the closed weapons bay doors. The crew jettisoned the released store on a subsequent range pass and returned home without further incident. Damage from the released store was discovered on the weapons bay doors.

Class E Events

• A B-2 crew experienced an unintended altitude deviation during a training sortie. The crew was climbing to an assigned altitude while using airspeed hold in the climb. The crew reduced the throttle setting in anticipation of level-off. The aircraft never made its assigned altitude, and in order to maintain the assigned airspeed at a reduced throttle setting, the aircraft began a gradual descent that was eventually noticed and quickly corrected.

• A heavyweight Spirit received a clearance to climb with minimum time to complete the maneuver. The pilot decided to trade altitude for airspeed and rapidly made the assigned altitude. Unfortunately, the B-2 had bled off airspeed to the point that they could not maintain the assigned altitude and were forced to descend.

The good news in all this is that we don't have any major mishaps to report in the B-2 community, and that allows us to "fine-tune" our flying skills through lessons learned in minor mishaps and events. The B-2 community enjoys a highly proactive safety working group that meets regularly to mitigate risks to ensure the Spirit, a national asset, continues in its tradition of safe flight while training and executing the mission.

FY04 B-52 Safety Review

The "Buff" community had a pretty good year for aviation safety with no Class A mishaps reported for FY04. The downside is that we saw an uptrend in all other categories when compared to FY03, with four Class Bs, 22 Class Cs, and 43 Class E events experienced this year. Much like the B-1B, the majority of mishaps in the B-52 can be attributed to engine malfunctions or incidents involving the engines.

Class B Mishaps

Three of the four Class B mishaps were a direct result of failed No. 2 bearings on various engines. These failures occurred on engines where the No. 2 bearings installed in the mishap engines were refurbished from older B-52 engines and simply failed without warning. Although oil loss was investigated on each incident, the investigation revealed that the bearing failures did not result from lack of lubrication; they simply failed from years of use. The common thread here is that these refurbished bearings were installed, but no historical records were brought with them to determine exactly how long the bearings were in-service prior to installation on the engines. Although they had been refurbished, they still retained the wear and tear "creep" from many years of service. Couple that with matching these bearings with different types of steel braces and the heat variants of these metals, and you can see the potential for failure. This type of failure points out the necessity for us as aircrew to be more involved with our maintenance members and discuss these incidents, especially when we are dealing with depot-level maintenance drop-offs and pick-ups. Make it a point to know what was done with the aircraft and the potential problem areas you may encounter, and take the time to talk trends with your fellow aircrew members.

Class Cs and Class Es

Surprisingly, when we look at the Class C mishaps, only nine of the 22 incidents were engine related (five FOD, one engine fire, one turbine failure, one oil temp overheat, and one bird strike). I say that simply because within the bomber community, in general, the majority of mishaps within each mishap category have been powerplant-related, and we are bucking the trend here! The real surprise though is that ground-related mishaps accounted for six of the remaining 13 Class C events (two towing incidents, three maintenance-related damage incidents, and one aircraft taxi incident). The remaining incidents occurred in-flight and ranged from a delayed disconnect during refueling, to a variety of component damage/failures (bomb door damage, right tip gear damage, left main gear banana link disconnected, hatch damage from boom contact, and a main gear actuator cylinder rupture). When we look at Class E mishaps, we return to the trend of engine-related malfunctions or engine-related incidents accounting for 33 out of 43 Class E events. Out of these 33 events, 12 of the in-flight shutdowns were associated with loss of oil pressure, 11 for high oil temperature, five engine overheat indications, two false engine fire indications, one CSD failure, one bearing oil scavenger line failure, and one failed fuel control.

USAF Photo

As we look ahead to FY05 in the bomber community, we should applying the lessons learned from the few incidents in FY04 to our day-to-day operations and pass this knowledge to our peers. As Douglas Adams once said, "Human beings, who are almost unique in having the ability to learn from the experience of others, are also remarkable for their apparent disinclination to do so." Pass the knowledge and the training on so that you and your personnel don't become a statistic. Fly Safe!

USAF Photo by SSgt Jocelyn Rich

B-1

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	2	8.60	14	60.22	0	0.00	0	0	23,249
5 YR AVG	0.8	3.34	7.8	32.58	0.2	0.84	0.0	0.0	23,940.8
10 YR AVG	0.6	2.45	4.9	19.98	0.3	1.22	0.2	0.4	24,528.3
LIFETIME CY84-FY04	16	3.64	57	12.97	7	1.59	6	11	439,448

B-2

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	0	0.00	0	0.0	0	0.00	0	0	7,758
5 YR AVG	0	0.00	1	8.94	0	0.00	0	0	6,709.8
10 YR AVG	0	0.00	0	7.90	0	0.00	0	0	5,062.4
LIFETIME FY90-FY04	0	0.00	4	7.59	0	0.00	0	0	52,718

B-52

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	0	0.00	4	14.69	0	0.00	0	0	27,227
5 YR AVG	0.0	0.00	3.2	12.15	0.0	0.00	0.0	0.0	26,346.8
10 YR AVG	0.1	0.40	1.7	6.82	0.0	0.00	0.0	0.0	24,925.5
LIFETIME CY55-FY04	97	1.27	180	2.36	76	1.00	99	315	7,623,347

BASH

FY04 End of Year Splat Stats

1LT MELANIE PRESUTO
PETER WINDLER
HQ AFSC/SEFW

Another fiscal year has come and gone, another year of dodging feathered bullets. Overall, we were successful avoiding those feathered fiends, but we did have a few major incidents. Once again we set another bird strike record with 4567 bird strikes reported for FY04. Fortunately, 98 percent (4477) of the bird strikes were Class E events. We had one Class A mishap which accounted for $42,494,800 (82 percent) of our total FY04 costs $52,033,959. There were eight Class B and 81 Class C wildlife mishaps resulting in $8,652,552 (16 percent) of our total costs. As usual about half (49 percent) of our strikes occurred in the airfield environment but only accounted for nine percent of our costs. Strikes occurring during low-level and range operations made up 87 percent of the cost but were only 12 percent of the total number.

The top ten enemy list changed little from previous years, with a few minor exceptions. We continue to strike many small passerines, mainly in the airfield environment, mostly resulting in minor damage. One exception is the Meadowlark (both Eastern and Western), which accounted for 98 strikes and $228,783 in damage. Killdeer and Kestrels (both American and Eurasian), typical airfield birds, are also significant damage producers, $547,735 and $212,704, respectively. The Rook made our top ten list for damage of $451,123, with only one strike.

Our aircrews, operations and safety personnel are doing a great job incorporating avoidance technologies into their operational risk management assessments before flying. Despite our best efforts, we continue to hit birds when we fly, but fortunately, through good risk management, only one Class A and eight Class B wildlife strike mishaps occurred during FY04. The single Class A mishap involved a Black Vulture engine ingestion on an F-15E during low-level operations, resulting in a loss of aircraft ($42,439,800). Of the eight Class B mishaps, six occurred near the airfield and the

FY04 Top 10 Wildlife Strikes by Count

Common Name	# Strikes	Cost
Swallows	175	$38,652
American Mourning Dove	163	$249,065
Horn Lark	145	$61,678
Eastern/Western Meadowlark	98	$228,783
Swifts	89	$16,473
Killdeer	81	$547,735
American/Eurasian Kestrel	68	$212,704
Warblers	64	$19,136
Bats	52	$800
Gulls	39	$218,582
Total	**974**	**$1,593,608**

FY04 Top 10 Wildlife Strikes by Cost

Common Name	Cost	# Strikes
Black Vulture	$42,858,050	21
Snow Goose	$1,521,830	5
Turkey Vulture	$812,266	18
Pigeons	$693,666	31
Killdeer	$547,735	81
Rook	$451,123	1
American Mourning Dove	$249,065	163
Eastern/Western Meadowlark	$228.783	98
Gulls	$218,582	39
American/Eurasian Kestrel	$212,704	68
Total	**$47,793,804**	**525**

FY04 Bird Strikes–Percent/Count/ Phase of Operation

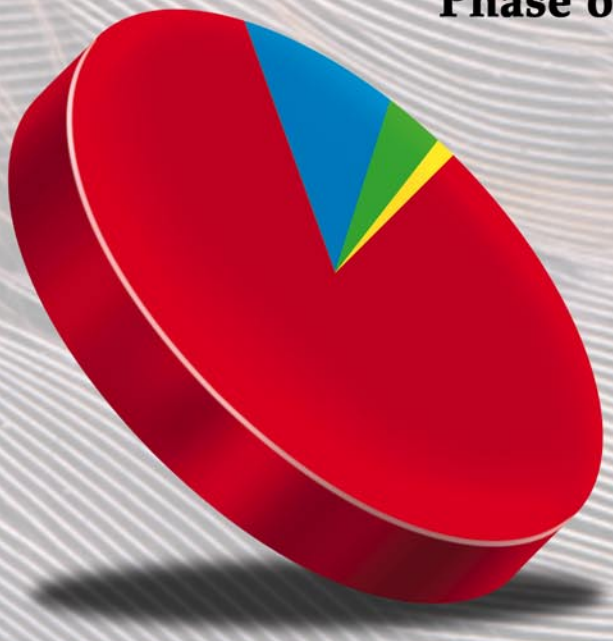
49%/2243
Airfield

36%/1651
Unknown

12%/540
Low-Level and Range Work

3%/134
En Route

FY04 Bird Strikes–Percent/Cost/ Phase of Operation



9%/$4,744,683
Airfield

2.4%/$1,498,623
Unknown

88%/$45,428,475
Low-Level and Range Work

0.6%/$317,178
En Route

other two during low-level and range operations. The two low-level strikes involved large birds—a Turkey Vulture and a Snow Goose. All but one of the airfield Class B strikes involved flocks of birds. The lone airfield Class B strike not involving a flock was a single Killdeer, weighing only three ounces, ingested into an F-16C engine, resulting in over a half million dollars in damage.

The good news through all of the statistical fog is most of our bird strikes are Class E events. We'll never eliminate bird strikes altogether; however, better to have Class E events than damaging mishaps with potential for loss of life or valuable resources. Keep up the vigilance and hard work avoiding those feathered bullets this next fiscal year. Hey…be careful out there!

A-10

LT COL MICHAEL BAUMGART
GERMAN AIR FORCE
HQ AFSC/SEFM

USAF Photo by SrA Greg L. Davis

The past year wasn't such a good one for the mighty Warthog community. In all, there were three Class A, six Class B, 31 Class C and 64 Class E mishaps—as compared to one, seven, 21 and 54, respectively, in FY03. Unfortunately, the Class A's accounted for one fatality.

This is a rate of 2.41 Class A mishaps per 100,000 flying hours, and it is pointing definitely in the wrong direction.

Class A Mishaps

The three A-10 Class A mishaps in FY04 resulted in one pilot fatality and two destroyed aircraft.

(1) The year's first Class A mishap:

While performing the tactical portion of the mission, the mishap aircraft experienced an engine compressor stall. At that time, the speed brakes on the aircraft were extended. The combination of the extended speed brakes and the loss of the right engine, created a situation in which the mishap pilot was unable to maintain a safe air speed without descending. Upon reaching the minimum safe ejection altitude without reestablishing safe flight parameters, the mishap pilot ejected without injuries.

(2) The year's second Class A mishap:

The mishap pilot was on a night vision goggle takeoff and landing upgrade sortie. The mishap occurred just two minutes after takeoff. The mishap aircraft gradually entered into a right banking turn with no correction. The mishap pilot attempted to eject, but the impact interrupted the ejection sequence.

(3) The year's third Class A mishap:

After more than one hour of flight the mishap pilot noticed and confirmed a left engine fire. After performing the boldface procedure for engine fire, the mishap pilot made a single-engine landing and emergency ground egressed the aircraft without injuries.

Class B Mishaps

The A-10 experienced six Class B mishaps in

FY04. Briefly stated are the circumstances of each Class B mishap:

• The mission was planned and flown as a single-ship air combat maneuver attack sortie. On the fourth engagement, the pilot rolled right and (momentarily) flew the mishap aircraft into the engine disturbance envelope. Preexisting damage to the compressor blades resulted in the mishap engine experiencing a minor compressor stall. The mishap pilot shut down the engine and recovered the aircraft uneventfully.

• The flight was planned as a Basic Surface Attack (SAT) mission. The mishap pilot perceived a brown streak pass by the right side of the canopy. The mishap pilot maneuvered, but felt an impact on the mishap aircraft, which turned out to be a turkey vulture, which was ingested into the engine. The strike deformed and fractured fan blades on the first-stage turbine, and the mishap pilot landed uneventfully, shut down on the runway, and egressed.

• The flight was briefed as a four-ship SAT mission. The mishap pilot was the flight lead performing instructor pilot duties. During the sortie, the outboard end of a pivot bolt broke free from the attached rib due to fatigue cracking. The mishap pilot shut down the mishap engine and performed a single-engine landing, shut down the engine, and egressed the aircraft.

• The mishap sortie was planned, briefed and flown as an SAT mission. A rivet worked loose during flight and exited the aircraft into the slipstream. The rivet was ingested in the left engine intake, impacting a fan blade, and was then passed into the compressor section. The mishap engine sustained major damage to the compressor section, and the mishap pilot shut down the engine and flew an emergency single-engine approach.

• The mishap aircraft returned from a routine Forward Air Controller Airborne continuation training sortie. The sortie was flown as planned, with no abnormal engine indications noted. During the post-flight inspection, maintenance personnel discovered damage to the No. 1 engine fan blades. The mishap engine is still under investigation to determine the cause of fan blade damage.

• The mishap pilot flew the aircraft on a single-ship Ground Forward Air Controller support sortie. During a two-second long-range strafe burst, the pilot heard an unusual sound as the gun ceased firing prior to the gun limiter stop. The mishap pilot terminated maneuvering and placed the gun switches to safe. During landing gear extension, both engines ingested gun parts that had exited as the nose landing gear wheel well opened, and sustained substantial foreign object damage.

Lessons Learned

Don't believe the old saying, "It doesn't happen to me." Don't increase your risk foolishly. Don't jeopardize your safety to impress yourself. Stay close to system data. As you know, the laws of physics are immutable!

Fly safe.

Don't jeopardize your safety to impress yourself.

US Army Photo by Sgt 1st Class Joe Belcher

A-10

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	3	2.41	6	4.81	2	1.60	1	1	124,640
5 YR AVG	2.0	1.71	7.2	6.14	2.0	1.71	1.0	1.0	117,277.0
10 YR AVG	2.0	1.67	4.1	3.42	1.9	1.58	0.9	0.9	119,978.0
LIFETIME CY72-FY04	100	2.36	85	2.00	101	2.38	51	58	4,243,585

Others:

USAF Photos

C-9

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	0	0.00	1	6.08	0	0.00	0	0	16,438
5 YR AVG	0.0	0.00	0.8	4.13	0.0	0.00	0.0	0.0	19,348.6
10 YR AVG	0.1	0.47	0.5	2.36	0.0	0.00	0.0	0.0	21,229.0
LIFETIME CY68-FY04	3	0.33	6	0.66	1	0.11	3	3	908,299

C-12

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	0	0.00	0	0.00	0	0.00	0	0	4,406
5 YR AVG	0.0	0.00	0.2	5.21	0.0	0.00	0.0	0.0	3,838.4
10 YR AVG	0.0	0.00	0.1	1.66	0.0	0.00	0.0	0.0	6,019.6
LIFETIME CY75-FY04	2	0.48	2	0.48	1	0.24	2	6	412,390

C-20

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	0	0.00	0	0.00	0	0.00	0	0	4,499
5 YR AVG	0.0	0.00	0.4	7.86	0.0	0.00	0.0	0.0	5,089.4
10 YR AVG	0.0	0.00	0.2	3.42	0.0	0.00	0.0	0.0	5,847.6
LIFETIME CY83-FY04	0	0.00	2	1.61	0	0.00	0	0	123,983

C-21

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	0	0.00	0	0.00	0	0.00	0	0	47,483
5 YR AVG	0.2	0.42	0.4	0.83	0.2	0.42	0.4	0.4	48,125.0
10 YR AVG	0.2	0.42	0.3	0.63	0.2	0.42	0.4	1.0	47,321.8
LIFETIME CY84-FY04	3	0.30	3	0.30	3	0.30	6	12	993,020

F-22

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	1	43.92	4	175.67	0	0.00	0	0	2,277
LIFETIME CY02-FY04	2	79.24	5	198.10	0	0.00	0	0	2,524

F-117

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	0	0.00	1	7.99	0	0.00	0	0	12,509
5 YR AVG	0.0	0.00	0.4	3.07	0.0	0.00	0.0	0.0	13,014.0
10 YR AVG	0.6	4.63	0.4	3.08	0.2	1.54	0.1	0.1	12,972.7
LIFETIME FY91-FY04	7	3.81	6	3.27	3	1.63	1	1	183,754

T-41

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	0	0.00	0	0.00	0	0.00	0	0	764
5 YR AVG	0	0.00	0	0.00	0	0.00	0	0	859
10 YR AVG	0	0.0	0	0.00	0	0.00	0	0	778
LIFETIME CY64-FY04	9	1.45	5	0.81	4	0.65	1	2	618,926

T-43

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	0	0.00	0	0.00	0	0.00	0	0	4,646
5 YR AVG	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.0	4,926.4
10 YR AVG	0.1	1.38	0.0	0.00	0.1	1.38	0.2	3.5	7,261.4
LIFETIME CY74-FY04	1	0.29	6	1.77	1	0.29	2	35	352,885

F-15

MAJ JASON SMITH
CANADIAN AIR FORCE
HQ AFSC/SEFF

As most of you are probably aware by now, FY04 was a pretty decent year in terms of Aviation safety. In fact, the title on the Air Force Times story on the subject was "A Banner Year for Safety." The overall Class A rate for FY04 was 1.06, a significant decrease from the 1.30 logged in FY03. Even more noteworthy, however, was the improvement seen in the Fighter/Attack rate. It came in at 1.30, down from 2.47 in FY03. In terms of raw numbers, there were nine Fighter/Attack mishaps in FY04 versus 17 in FY03. The improved Fighter/Attack numbers were clearly the difference in FY04.

So, how did the mighty Eagle's safety record work into this whole equation? Did it help or hurt the numbers? Well, I'm pleased to report that the F-15 also saw a decrease in the Class A rate this year. In fact, for the second consecutive year the Eagle's rate declined, coming in at 1.55, down from 2.07 in FY03, and 2.57 in FY02. There were a total of four Class A mishaps this past year, three of which were "flight" mishaps and counted toward the rate. The best stat, however, is the second consecutive "goose-egg" under the Fatalities column. While three jets did not make it home, all the aviators did, thanks to the continued outstanding performance of the ACES II ejection seat. Let's take a closer look at the Class A mishaps from last year.

• (From the Preliminary message). An F-15A was undergoing a "hush house" run to troubleshoot an earlier engine malfunction. During the run, the No. 1 engine ingested Foreign Object(s) (FO), but no anomalies were noted at the time by the technicians. The engine run was terminated due to an unrelated maintenance issue, and the FO damage was discovered later. A borescope inspection revealed extensive and irreparable damage to the fan and core.

• (The following is taken from the Accident Investigation Board [AIB] report.) A Strike Eagle was participating in a low-level, two-ship Surface Attack Tactics (SAT) training mission. Following simulated weapons delivery, the crew was flying at approximately 700 feet AGL while initiating a rejoin with the lead aircraft. The pilot saw a black object flash by in his peripheral vision immediately before hearing two impacts and an explosion on the right side of the aircraft. The pilot initiated a climb and informed his lead that he had struck a bird. The jet tended to roll to the right, but the pilot was able to compensate using a combination of full left rudder and aileron inputs, and reducing power on the left engine. Although there were no cockpit indications of a fire, both crewmembers could see that the right engine was on fire. The crew discharged the fire suppression system and shut down the right engine. When the pilot relaxed aileron and rudder pressure, the jet began a right roll to the inverted position. The pilot allowed the roll to continue until the jet was upright, and then applied full stick and rudder inputs to maintain a slight right bank. The fire appeared to have diminished, but by this time the crew determined they could not control the aircraft and initiated successful ejections.

The investigation determined conclusively that the right engine experienced a catastrophic failure due to ingesting a large Black Vulture. The impact resulted in an uncontained disintegration of fan, compressor and turbine blades, which led to a major engine fire. The loss of control capability was due to severed flight control cables, wiring harnesses, and hydraulic system failures. The AIB also noted that the flight lead should have initiated a climb earlier to comply with BASH restrictions.

• (The following is taken from the AIB's report). An F-15C crashed approximately 50 miles from base. While engaged in a 3000-foot defensive Basic Fighter Maneuvers (BFM) engagement, the pilot was ejected from the aircraft. The aircraft continued to fly for approximately one minute and forty-nine seconds before it impacted the ground. The aircraft was destroyed upon impact, but the pilot sustained only superficial injuries. The AIB determined that the following sequence of events caused the mishap:

—For an unknown reason, the pilot's connector to regulator unit (CRU-94/P) became detached from his torso harness dovetail bracket. Additionally, the pilot's COMBAT EDGE vest hose was not attached to the CRU 94/P as it normally would be. This allowed the detached CRU 94/P to reach the area of the right ejection handle;

—The detached CRU 94/P became lodged in the cavity of the ejection seat right handle;

—The pilot turned his head to the right to look over his right shoulder to view his six o'clock high position and pulled the stick back toward him; and

—The pilot's movement placed enough tension on the oxygen hose and CRU-94/P to raise the ejection seat handle and initiate the ejection sequence.

• (The following is taken from the AIB's report). An F-15C experienced dual engine flameouts during a Weapons Instructor Course, Instructor Pilot upgrade BFM mission. Unable to restart the engines, the pilot ejected safely; the aircraft crashed and was destroyed.

The AIB determined the cause of the simultaneous flameout of both engines was loss of fuel flow. They attributed the loss of fuel flow to the inadvertent activation of the Left and Right Fire Warning pushbuttons, which closed both airframe-mounted fuel shutoff valves. In the Board's opinion, the pilot inadvertently bumped or pushed the Fire Warning Light pushbuttons as he prepared for the defensive BFM engagement. Compounding the already serious double engine failure was a total loss of electrical power, which occurred due to low airspeed and corresponding decaying RPM on both engines. The AIB reported that since neither of the Fire Warning pushbuttons were reset, the fuel shutoff valves remained closed, preventing a successful restart of the engines. Without at least one engine operating, the aircraft was unrecoverable.

USAF Photo by TSgt Ben Bloker

Class B Mishaps

There were 13 Class B mishaps in FY04, eight of which were engine-related. Engine damage is very expensive to repair, and that trend is certainly going nowhere but up. The engine-related mishaps included over-temps, several instances of FO damage, a bird strike, and a low-pressure turbine blade failure.

As for other Class B mishaps, an F-15A departed the runway while landing in heavy crosswind conditions, while another jet experienced a brake fire when the pilot aborted the takeoff roll at high speed. A couple of "dropped object" occurrences also rang the cash register to the tune of greater than $200K each. In one case, the seemingly innocuous loss of an anti-collision light lens resulted in Class B damage when the lens struck one of the vertical tail surfaces. Another incident involved an in-flight failure of a horizontal stabilator leading edge. The leading edge, or "forward box" as it is commonly known, was one of the "Gridlock" assemblies that have proven problematic in the recent past. Losing a forward box assembly usually results in Class C damage, but in this case the piece struck the rudder and bumped the total damage over the Class B threshold.

Other Mishaps and Events

Of the over 200 other mishaps and events reported last year, several themes stand out. As alluded to above, horizontal stab forward box departures usually result in Class C damage, and there were six of these reported. Three of the six involved the Gridlock versions, so even though all reports are that the manufacturing problems have been resolved, there are still some of the "less-than-robust" assemblies in use that were produced earlier.

Sharing airspace with aviators of the feathered variety continues to prove costly. In addition to taking out a Strike Eagle as explained earlier, I count over 120 other cases where birds failed to "see and avoid" (notice I blame the birds!). Seriously, though, one of these instances resulted in a Class B, and eight others caused enough damage to be reported as Class Cs. Even though the airplane usually wins this 1 v X, the AF often must pull out its wallet to pay for the damage.

It's a rare case when we come up with a new way to have a mishap.

USAF Photo by SSgt Lee O. Tucker

FY04 also saw the trend of jets departing controlled flight continue to cause extra work for maintainers and FSOs. Fortunately, we didn't see anything worse than a Class E result, but one can't help but think it's just a matter of time before we have a more serious outcome. Similar to the last few years, we see flight control mis-rigging and/or other failures in the flight control system blamed for the majority of departures. The F-15's age is no doubt a factor, particularly where mechanical flight controls are involved. As most of you are aware, the F-15 uses both mechanical (cables and pulleys, etc.) and electronic flight controls. Efforts are underway at the depot level to improve "refurbishment" procedures, particular for the mechanical aspects of the flight controls. Another major endeavor is underway to develop improved diagnostic tools to assist maintainers in troubleshooting flight control problems. By being better able to determine the cause of the problems, we'll be able to focus our preventive efforts more effectively.

Lessons Learned

As mentioned, FY04 marked the second consecutive year that Eagle Class A rates declined. To what do we attribute this encouraging trend? Are Eagle drivers and maintainers "going to school" on the lessons from the past? It's a rare case when we come up with a new way to have a mishap; we generally tend to repeat the mistakes of those before us. It all comes down to risk management of course, but many of the hazards have already been identified, and many of the control measures are already in place. In keeping with that theme, the past year's mishaps have only served as reminders of hazards established long ago. Everyone is well aware of the dangers posed by FOD, but despite our efforts FOD was still responsible for millions of dollars worth of damage last year. The same applies to bird strikes. There's probably a limit to how much we can reduce this hazard and still fly, but we must remain proactive, and always keep in mind the potentially grave consequences of pushing established BASH restrictions perhaps a little too far. We were also reminded of the importance of properly connecting all Life Support Equipment. It's amazing how "Murphy" can take advantage of something as seemingly minor as not connecting a COMBAT EDGE vest hose.

In spite of the reminders provided courtesy of FY04's mishaps and events, it remains that the Class A rate improved, so y'all must be doing something right. Give yourselves a collective "pat on the back" for last year, but strive for an even better record this year. Here's to keeping the "hostiles" splashing and the targets disappearing in '05!

F-15

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	3	1.55	10	5.16	3	1.55	0	0	193,731
5 YR AVG	3.6	1.90	13.2	6.98	2.0	1.06	0.6	0.6	189,053.4
10 YR AVG	4.0	2.08	9.2	4.79	2.6	1.35	0.5	0.7	192,205.2
LIFETIME CY72-FY04	123	2.46	220	4.40	107	2.14	38	45	5,002,207

Helicopters

USAF Photo by SSgt Matthew Hannen

LT COL THOMAS M. ROY
HQ AFSC/SEFF

Overall, FY04 was a better year in the Air Force helicopter world in terms of the benchmark Class A mishap rate, with just two Class A mishaps, both operationally related. This, in contrast with the four in FY03 and nine in FY02, shows significant improvement, even though our operational tempo remained extremely high, and our operational mission load was still predominantly in high-density altitude, extremely demanding desert environments. This statistical improvement, however, does not diminish the fact that we tragically lost five heroic service members in an MH-53 operational mission mishap, the first Class A of FY04.

In regard to Class B and C mishaps and Class E events, FY04 showed improvement over FY03, but still trended above five- and ten-year averages.

	Class A FY03/04	Class B FY03/04	Class C FY03/04	Class E FY03/04
H-1	**0/0**	**0/0**	**1/5**	**29/27**
H-53	**3/2**	**3/1**	**14/13**	**17/31**
H-60	**1/0**	**0/1**	**11/7**	**67/59**
Total	**4/2**	**3/2**	**26/25**	**113/117**

MH-53

The MH-53 experienced two Class A mishaps, one Class B and 13 Class C mishaps in FY04, showing significant improvement over FY03.

The first FY04 Class A occurred during the en route phase of infiltration/exfiltration operations supporting the Joint Special Operations Task Force (JSOTF). The mishap aircraft (MA), number two of a two-ship formation on their third round-robin sortie of the day, was climbing to clear mountainous terrain when the mishap occurred.

Approximately five minutes after takeoff, the MA experienced a compressor stall in the No. 2 engine, causing engine failure. Reversing course, the mishap crew (MC) attempted to jettison the auxiliary fuel tanks without success. Dumping fuel to reduce weight and unable to maintain single-engine flight, the MC set up for a precautionary landing. During the landing phase, at 150-200 feet AGL, the remaining engine lost power and the MA landed fast on a level, rocky river bank, subsequently ran into a three-foot-high embankment that severed the tail boom, rolled left and came to rest inverted. A post-crash fire rapidly consumed the aircraft.

By clear and convincing evidence, the Accident Investigation Board determined the causes of this accident were the failure of the No. 2 engine due to compressor stall, failure of the auxiliary fuel tanks to jettison, and the uneven terrain of the landing area. Contributing factors included the subsequent failure of the No. 1 engine when the demands of the high altitude and high gross weight caused an over-

USAF Photo

temperature and compressor stall; and insufficient written guidance on checking the auxiliary fuel tank jettison system. This crew did everything right, performing flawlessly under extreme pressure, but tragically, four Airmen and one Soldier perished.

The second Class A mishap of FY04 involved a redeploying MH-53 flying in the vicinity of forecast isolated thunderstorms on an instrument flight plan. Shortly after entering a rain shower, the crew saw a bright flash of lightning on the left side of the aircraft and heard a loud bang. The aircraft did not exhibit any damage, so the crew continued flight to home station.

No damage was found during post-flight or during the lightning strike checklist inspection. During a subsequent preflight inspection, 12 days later, significant lightning damage was discovered crossing the Class A cost threshold.

The single MH-53 Class B mishap involved the No. 1 engine ingesting a foreign object, most likely a rivet lodged in the Engine Air Particle Separator (EAPS) from past maintenance, during ground runs. The object caused significant engine damage.

HH-60

The HH-60 experienced no Class A mishaps in FY04, one Class B mishap and seven Class C mishaps, also showing significant improvement over FY03 statistics.

The Class B involved engine over-temp/over-speed damage necessitating engine replacement. The mishap crew experienced a torque split and rotor RPM (N_r) droop causing an uninitiated descent during an 80-foot hover training operation. The crew successfully executed an emergency brown-out landing, then experienced erratic N_r governing and engine torque-matching once on the ground. The crew shut down the aircraft and coordinated for maintenance.

Maintenance support arrived and troubleshot the aircraft. Suspecting a torque indication failure, a decision was made to ferry the aircraft to home station. Early in the flight, the aircraft again exhibited torque split indications, combined with a significant engine over-speed/over-temp condition. The crew executed a precautionary landing at an auxiliary field and shut the aircraft down uneventfully.

H-1

The H-1 experienced another year with no Class A or B mishaps. However, the H-1 did experience five Class C mishaps in FY04, slightly above average for this airframe. Two of the mishaps involved engine over-speeds in aircraft executing manual fuel operations, one conducting training, and the other during a functional check flight. Two more involved engine malfunctions/failures resulting in successful single-engine emergency landings. The fifth mishap occurred on a hospital rooftop helipad where a flush-mounted elevator ascended into the aircraft structure during a patient drop-off.

Conclusion

Lessons learned this year are difficult to roll up, as there were no significant mishap trends, and statistically FY04 showed improvement over the two previous years. Our two Class A mishaps were largely a result of the dangerous and demanding low-level mission environment in which the helicopter community operates.

If a trend can be drawn from the Class B and C mishaps, it would be a need for an increased attention to detail across the board—mission planning, aircrew procedural discipline and maintenance discipline, all played a role. As a whole, the mishap history of FY04 continues to reinforce the need for a comprehensive focus on operational risk management (ORM). Leadership must continue to assess mission risk, input all controls available, make the tough mission cost/benefit decisions, and above all, accept no unnecessary risk. Please fly safe!

H-1

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	0	0.00	0	0.00	0	0.00	0	0	20,030
5 YR AVG	0.4	2.05	0.0	0.00	0.4	2.05	0.0	0.0	19,495.2
10 YR AVG	0.5	2.48	0.0	0.00	0.5	2.48	0.0	0.0	20,143.1
LIFETIME CY59-FY04	54	3.28	14	0.85	40	2.43	21	52	1,647,304

H-53

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	2	18.33	0	0.00	1	9.16	1	5	10,912
5 YR AVG	2.2	17.72	1.8	14.49	0.6	4.83	0.2	1.0	12,418.4
10 YR AVG	1.3	11.36	1.0	8.74	0.4	3.49	0.1	0.6	11,446.5
LIFETIME CY66-FY04	38	7.76	25	5.11	23	4.70	25	86	489,712

H-60

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	0	0.00	1	3.69	0	0.00	0	0	27,074
5 YR AVG	1.0	3.89	0.4	1.56	0.4	1.56	0.4	1.2	25,716.0
10 YR AVG	0.7	2.68	0.3	1.15	0.5	1.91	0.8	2.3	26,145.0
LIFETIME FY82-FY04	13	3.45	4	1.06	9	2.39	11	40	376,777

US Army Photo by Spc Ryan C. Creel

Trainers:
T-1, T-6, T-37 and T-38

CMSGT JEFF MOENING
HQ AFSC/SEFF

The Trainers had a bad year in that two aviators lost their lives in a needless mishap. There were two Class A trainer mishaps, the T-6 mishap that claimed two lives and a T-38 that lost control in-flight resulting in a destroyed aircraft but successful aircrew ejection. We will look at the Class A's in detail from the AIB report information, and go over the basics of the Class B mishaps. I will also touch on the Class C mishaps and E events that occurred in FY04. If you want/need to read the SIB reports please utilize AFSAS. To start, let's look at the two Class A mishaps.

T-6 Class A

The aircraft was on a continuation training cross-country mission with two aircrew members onboard. The crew had been cleared for takeoff and one left closed traffic pattern before departing under VFR to the west. After takeoff, the crew retracted the landing gear and flaps, leveled off at 30 feet above the runway, accelerated to 168 knots, pitched up 37 degrees nose-high (3.6 Gs) climbing to an altitude of 530 feet, while simultaneously rolling into 131 degrees of left bank (nearly inverted). One aircrew member ejected at an altitude of 337 feet AGL, three seconds prior to impact in a 45-degree nose-down attitude.

The AIB determined that pilot error was the cause of the mishap. For unknown reasons, the pilot flying the aircraft performed a closed pattern exceeding the maximum bank angle of 90 degrees and allowed his airspeed to decrease to 131 knots, below the minimum airspeed of 140 knots as required by AFM 11-248. The 37-degree 3.6 G pitch-up, coupled with the high bank angle and slow airspeed, caused the aircraft to stall and roll further towards inverted flight. The aircrew made no attempt to apply proper stall recovery procedures. As a result, the aircraft was nearly inverted at a much lower than normal altitude and was too low for safe ejection. The pilot ejected outside of the survivable ejection envelope. The other pilot did not eject. All aircraft engine and flight control systems were operating normally when the aircraft crashed.

There are many lessons to be learned about airmanship and following established procedures in this mishap. Were these pilots cowboys or just overly aggressive? Unfortunately, they are not able to tell us.

T-38 Class A

The aircraft crashed during initial takeoff with a student and instructor on board; both ejected safely. Immediately after takeoff, the aircraft experienced a series of rolls that increased in magnitude and rate. Liftoff occurred slightly early at approximately 155 knots. The aircraft then experienced an aerodynamic disturbance (characterized as wing "dips") at bank angles of less than 20 degrees. The sequence continued with a left roll to approximately 30-45 degrees and then a right roll to approximately 40-50 degrees. The instructor came on the controls to try to arrest the roll by neutralizing the stick with slight forward pressure. The aircraft again rolled to a left bank of approximately 50-60 degrees and

USAF Photo by SSgt Jeffrey Allen
Photo Illustration by Dan Harman

back to the right 60-70 degrees. At that point, the instructor decided the aircraft was not responding to his inputs and commanded ejection. The aircraft rolled left again and the instructor ejected at 45 degrees left bank. The student delayed ejection to obtain a more favorable position and ejected very shortly after the left wingtip contacted the runway in 35-40 degrees of left bank. The entire sequence occurred at less than 100 feet above the ground.

The AIB could not determine cause by clear and convincing evidence. However, there was substantial evidence to support two contributing factors: inexperience of the student and improper transfer of controls between the student and instructor. Most likely, due to inexperience the student over-controlled the roll in response to the disturbance immediately after takeoff. This over-controlling continued until the instructor came on the controls and stated, "I have the aircraft." However, the student did not hear the instructor and continued to control the aircraft, leading to a situation where both pilots were on the controls, neither aware of the other. The rolling continued and the instructor perceived the aircraft was not responding and commanded ejection.

Anyone who has flown a multi-place aircraft can attest to the need for proper transfer of control between pilots. No aircraft can have two people flying at the same time. Maybe from this mishap we can re-learn proper crew resource management and communication. Two critical safety-of-flight areas that can keep you alive.

Class B Mishaps

Now, let's take a look at the six Class B mishaps. There was one in the T-1, two in the T-6 and three in the T-38 community.

The T-1 mishap was a runway excursion that resulted in damage to the aircraft. The aircraft landed on a wet runway for a full-stop landing. When the aircrew attempted to turn onto the perpendicular taxiway at the end of the runway, the aircraft entered a skid and departed the prepared surface due to the taxi speed and standing water on the runway/taxiway. The aircraft came to rest approximately 60 feet off the taxiway surface and 200 feet left of runway centerline. The aircraft sustained damage to the nose gear, right wing and main gear, resulting in Class B damage.

The T-6 had one engine mishap from a Reduction Gear Box (RGB) failure and one intentional gear-up landing after a part failure. The engine failure came during an FCF when the aircrew experienced a chip light, engine vibration, and decreased power during the FCF profile. The gear-up landing came after the crew noticed a slight rumble and a lack of expected performance for a clean aircraft. The crew flew over the runway supervisory unit (RSU) and the RSU reported the aircraft had something hanging beneath the right wing. A chase ship (CS) confirmed the outboard main landing gear (OBMLG) door was disconnected from the main gear strut and hanging beneath the wing. When the crew attempted to lower the landing gear, the right main landing gear (MLG) would only partially extend, and the crew

was unable to obtain a safe right MLG gear-down indication. The instructor performed a gear-up landing from the rear cockpit while the upgrade pilot performed pre-coordinated emergency actions.

The T-38 had one engine compressor blade failure, a high-speed abort that resulted in a runway excursion, and an intentional gear-up landing. The engine mishap occurred during a maintenance ground run when the No. 1 compressor blade failed due to high-cycle fatigue. The runway excursion occurred after a high-speed abort and the barrier was slow to rise. The aircraft became partially entangled in the barrier, began a wide sweeping left skid/right turn/clockwise spin about the right stanchion. After 90 degrees of left skid/right turn/clockwise spin the main gear collapsed and the aircraft came to rest after 160 degrees of heading change. The aircraft sustained substantial damage to the gear, left wing tip, flaps and boattail. The crew egressed without injury.

The last Class B occurred after the crew evaded a large bird on landing and hit an object that damaged the landing gear. The crew then made a gear up landing.

The Class Bs have a variety of lessons that can be learned. For a full list of the lessons you will have to access AFSAS and read the reports that I cannot print here. The big lesson is know your procedures and be ready for anything from engine failure to birds in your flightpath on landing. Be ready and be aware.

Class C Mishaps and E Events

Let's take a quick look at the Class C and Es the trainers experienced this past year. All aircraft had bird strikes as the number one cause of the Class E mishaps. I bet that's no surprise to any FSO out there. We all know the BASH procedures and how to avoid birds; we just need to ensure we don't forget them and pay ever closer attention to the bird hazard condition for your flight. Thanks to all the units for the great reporting of the Class Es.

To look at the other mishaps, let's start with the T-38. The number two cause of the Cs and Es is engines. I bet that is no surprise to the T-38 drivers and maintainers. If you haven't gone over your in-flight engine shutdown procedures and single-engine landing requirements, then you should. The good thing is that FOD was only the cause of three T-38 engine mishaps, so good on you for that. It will take a whole lot more space than I have to go in-depth on all the engine issues, but be aware of the potential. Your wing flight safety office will be able to tell you all about what is happening at your unit. There were four cases where one of the T-38's canopies left the aircraft during flight or on takeoff or landing roll. Make sure the lid is fully closed and locked before you depart, and if you become a convertible in-flight, make sure you know the procedures for recovering the aircraft. The other main Class E category was smoke and fumes in the cockpit. The incidents come from a variety of sources, with the ACM being the main cause, followed by the coalescer sock. Another area for concern was the 12 NMAC that were reported last year. Thanks for the honest reporting and make sure you are constantly looking for the other aircraft that isn't looking for you.

The number one cause of the Class Cs in the T-37 world was engines and smoke and fumes. Engines had a variety of causes that showed no real trends. Visit your local safety office for your base trend data. The smoke and fumes incidents were varied, with 12 different causes listed. I couldn't get a good pick on trends other than failed garlock, carbon or ADG seals which are very hard to predict. There were 41 Class E mishaps reported for smoke and fumes, so the safety folks were busy. What does this mean to the aircrew? Be alert, be ready and know your smoke and fumes checklist. The other Class E trend that stands out is the physiological, with 52 reports entered into AFSAS. The student environment and the number for improper straining procedures tops the list of causes. The question I have is what can we do about changing this trend? You tell us.

For the T-6, physiological events was the number two cause, and once again the students were the culprit. What else can I say? Gear problems were the number three cause of mishaps/events, with six reported. Some causes were dropped objects and gear door failures. There were no other major trends in the community, but the three reports of flight control failures, to include one where the flight controls were restricted, could easily have been Class A's. Keep your eyes open, and for the maintainers who read this, make sure your flight control measures are top-notch. Maybe this should be a special interest item for the flight safety team.

The last aircraft to look at is the T-1. Smoke and fumes is the number two cause, with the Audio Amp being the main culprit, followed by the avionics blower motor and the coalescer sock. The amp and blower are fly-to-fail parts, so be ready for a few more. Engines had their fair share this past year with 10 mishaps, two due to FOD. I could see no other real engine trends. A couple of Class Cs that need to be mentioned are: aircraft flight controls damaged by an F-16's engine blast and a person injured when the entrance stair broke. Watch your parking plan wherever you park, as others may not be aware of how sensitive your aircraft is to wind gusts. Be ready for everything on the line and in the air, as the incidents above show that anything can, and will, happen. The key is your efforts to mitigate the risk and reduce the mishaps.

Have a great FY05. Fly Safe and Fly Smart!

USAF Photo by SSgt Jeffrey Allen

T-1

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	0	0.00	1	1.00	0	0.00	0	0	100,180
5 YR AVG	0.2	0.20	1.4	1.39	0.0	0.00	0.0	0.0	100,479.2
10 YR AVG	0.1	0.12	0.8	0.93	0.0	0.00	0.0	0.0	85,997.3
LIFETIME FY92-FY04	1	0.11	8	0.91	0	0.00	0	0	878,037

T-6

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	1	1.93	2	3.85	1	1.93	2	2	51,928
5 YR AVG	0.4	1.50	0.8	3.00	0.4	1.50	0.4	0.4	26,657.6
LIFETIME FY00-FY04	2	1.50	4	3.00	2	1.50	2	2	133,288

T-37

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	0	0.00	0	0.00	0	0.00	0	0	174,966
5 YR AVG	0.8	0.42	0.0	0.00	0.8	0.42	0.2	0.6	189,046.4
10 YR AVG	0.6	0.34	0.0	0.00	0.6	0.34	0.1	0.3	176,949.5
LIFETIME CY56-FY04	137	1.03	31	0.23	135	1.02	27	78	13,265,891

T-38

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY04	1	0.65	2	1.30	0	0.00	0	0	154,258
5 YR AVG	1.0	0.68	1.0	0.68	1.0	0.68	0.2	0.4	146,933.8
10 YR AVG	0.7	0.48	0.6	0.42	0.8	0.55	0.1	0.2	144,508.4
LIFETIME CY60-FY04	194	1.48	95	0.73	188	1.44	76	136	13,083,062

Maintenance

MAJ MICHAEL SHETLER
HQ AFSC/SEFM

Looking back at FY04, it wasn't a good year in regards to maintenance-related mishaps. The USAF experienced two less Class A maintenance-related mishaps in FY04 compared to FY03; however, one of the mishaps involved a fatality which occurred while performing maintenance on a C-17. To put it in a dollar figure perspective, maintainers were responsible for $10,433,572 worth of damage to aircraft. The following four mishaps highlight the Class A damage to aircraft.

Class A Mishaps

• Engine Damage During Test Cell Run—The forward balance ring was mis-assembled. During engine start, the balance ring separated and was ingested into the engine.

• 1st Stage Fan Blade Failure—Maintenance personnel failed to detect a propagating crack during scheduled and unscheduled engine inspections over the course of 3088 flying hours and 29 months.

• Engine Damage During Test Cell Run—During repair of the engine, the nut which secured the variable stator vane (VSV) bellcrank forward bolt was removed and not replaced. While performing the engine run, the VSV bolt liberated, resulting in a compressor stall, over-temp, and high pressure turbine (HPT) and low pressure turbine (LPT) damage.

• Fatality While Performing Mainten-ance—A maintenance person crawled beneath a powered open spoiler and disconnected the cannon plugs. The spoiler retracted to the closed position, resulting in fatal injury.

In Class B mishaps, the USAF experienced the same amount of maintenance-related mishaps in FY04 as we did in FY03—not very good progress on Secretary Rumsfeld's challenge to reduce mishaps by 50 percent in two years. Again, to put the amount of Class B damage in a dollar figure perspective, maintainers were responsible for $5,584,814 worth of damage to aircraft. The following 12 mishaps highlight the types of Class B mishaps that we saw in FY04.

Class B Mishaps

• Engine Hot Start—The right external Rear Compressor Variable Vanes (RCVVs) actuator clevis was misrigged. This, along with pilot procedures, contributed to an overtemp of the LPT and HPT.

• Engine FOD—Sometime during panel F67 modification, a rivet became lodged in a vent cavity. It was not discovered and was later ingested into the engine.

• Canopy Jettison—Maintenance personnel were conducting an Alternate Gear Extension Ops Check. The crew chief misidentified the Canopy Jettison Handle as the Alternate Gear Handle, removed the safety pin and pulled the handle.

• Engine Overtemp During Ground Run—Engine run technician did not notice impending engine hot

USAF Photos
Photo Illustration by Dan Harman

start and failed to shut down engine IAW tech orders.

• Engine FOD—The Engine Air Particle Separator (EAPS) seal rivets were ingested into the engine during the first flight after phase maintenance.

• Integral Jacking—Jacking team failed to follow the T.O. and damaged the right main landing gear (RMLG) door and shock strut.

• Engine Damage—The lower left bellcrank assembly was misassembled and the bolt/bushing/nut were installed incorrectly, resulting in damage to the compressor.

• Engine Damage—HARM Targeting System (HTS) pod cover was ingested into the engine during engine start.

• Gun Damage—The gun roll pin was not installed in the gun's cocking lever during maintenance, resulting in significant damage during a strafe pass. Upon landing gear extension, several gun pieces were ingested into both engines.

• Engine FOD—Incorrect bolts were installed in the forward weapon bay tunnel panels and one became loose and was ingested into the engine.

• Towing Mishap—Aircraft contacted a clear water rinse structure on the taxiway, resulting in nose gear collapse and damage to the right wing.

• Engine Bay Fire—The retaining bolt on the fan/core spraybar was not tightened after replacement, resulting in a fire that burned critical flight control wiring harnesses.

Lessons Learned

How many times have you said or heard someone say, "Follow the T.O." or "Do it by the book"? We've all heard these repeated over and over throughout our careers. Unfortunately, maintainers continue to ignore these three to five simple words because we continue to see cases year after year where maintainers don't follow the T.O. and wind up damaging aircraft and equipment.

A few months back, we published the "Top Ten Causes of Maintenance Mishaps" (August 2004, *Flying Safety*). When you peel back the onion and look a little deeper at these 16 mishaps in FY04, the leading contributors were "Failure to follow published Tech Data or local instructions," followed by "Inattention to detail/complacency," and "Incorrectly installed hardware on an aircraft/engine." As you can read, we're not creating new ways to damage equipment and injure ourselves, but merely making the same mistakes over and over again.

This past summer I had the unfortunate opportunity to investigate why an experienced maintainer was fatally injured while performing routine maintenance. Some of the first questions that came to mind were "How did this tragedy happen?" and "Why did this happen?" As the investigation unfolded, I quickly became infuriated at why an individual or group of maintainers would attempt such a dangerous procedure that was found nowhere in the T.O.

Many times we find ourselves falling into the rut of doing things the way we've always done them or cutting corners so we can get the tail number back on the flying schedule. Nothing is more important than doing the job safely and correctly the first time.

Just remember the next time when it's 0-dark-thirty and you're out on the ramp working a write-up to get the aircraft "greened up" for the day's flying schedule…think back to the kinds of mistakes you just read about and vow to yourself and coworkers that you'll "Do it by the book." In many cases, yours and your pilots' lives depend on it.

UAVs
UNMANNED AERIAL VEHICLES

MAJ CHRISTOPHER P. FROESCHNER
HQ AFSC/SEFF

The Unmanned Aerial Vehicle (UAV) continues to be a very active community that provides a critical component to the Air Force arsenal. The UAV community is composed of three main platforms:

- The RQ/MQ-1 Predator Remotely Piloted Vehicle (RPV).
- The RQ-4 Global Hawk UAV.
- The QF-4 Full Scale Aerial Target (FSAT) platform, which flies as a "manned" platform as well as an unmanned vehicle.

The RQ-1 Predator

The RQ-1 and MQ-1 Predators are medium-altitude, long-endurance unmanned aerial vehicle systems with a primary mission of interdiction and armed reconnaissance against critical, perishable targets. The basic crew for the Predator is one pilot and two sensor operators. This year, the Predator experienced four Class A mishaps, which resulted in three destroyed RPVs, and three Class C mishaps.

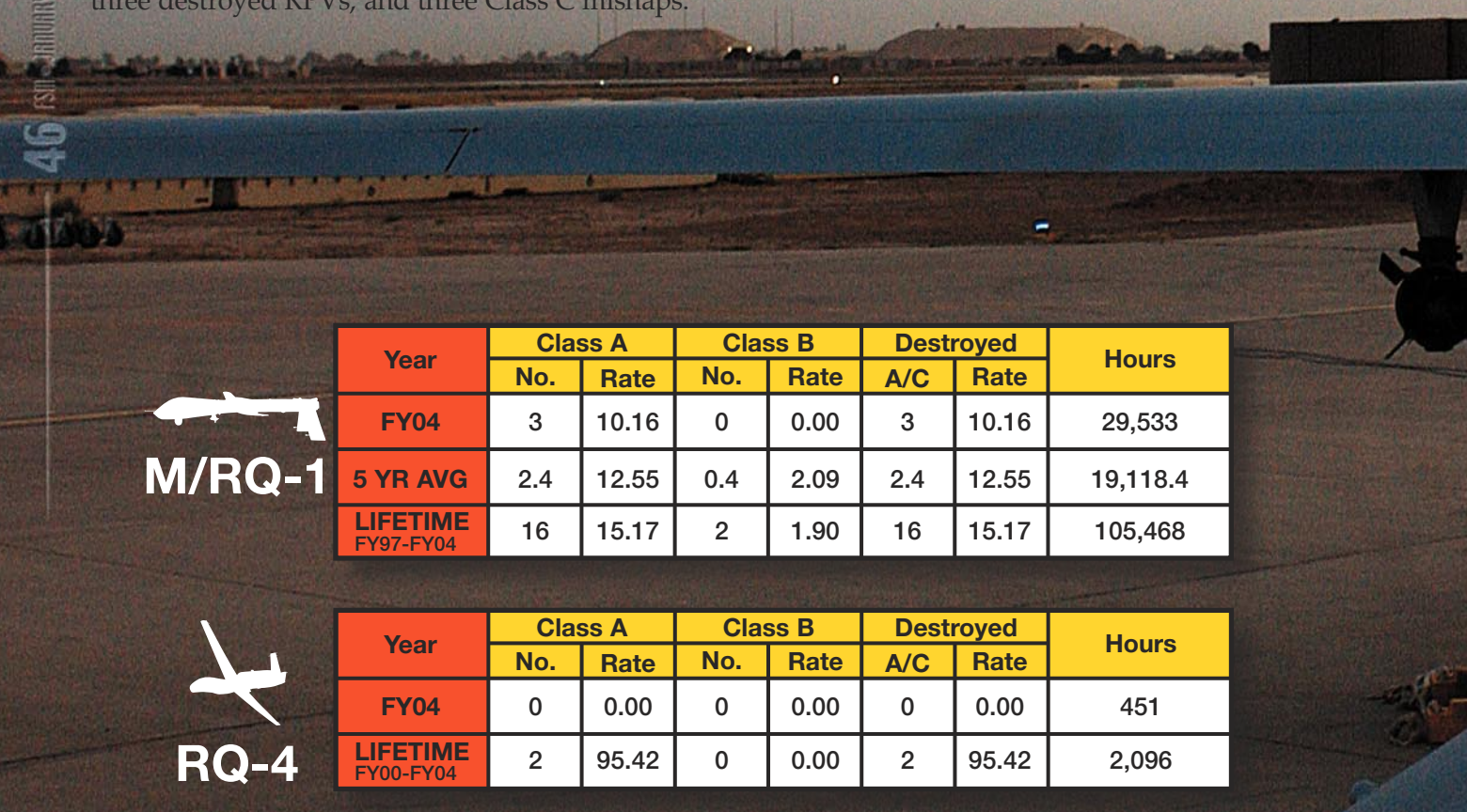
Class A Mishaps

—An RQ-1 crew experienced loss of control. A software anomaly allowed for pitch trim inputs to revert to the last input trim after an airspeed hold was removed. When the pilot removed airspeed hold, the RPV pitched up nose-high. The pilot continued to try to fix the control problem, lost command link with the aircraft, and the RPV departed controlled flight and was destroyed on ground impact.

—An MQ-1 experienced a hard landing upon return from the mission. On approach, an excessive sink rate developed and was not caught prior to RPV touchdown. The Predator porpoised several times down the runway and came to a stop with gear collapsed and damage to the Multi-Spectrum Targeting System.

—An MQ-1 experienced an engine fire and subsequent engine seizure that resulted in loss of command link and subsequent crash and total destruction of the RPV.

—An MQ-1 crashed on a landing attempt. The approach was high, and then the RPV was directed to dive to resume glidepath. A late flare maneuver and touchdown short of the displaced threshold resulted in the tail section catching an extended BAK-12 cable at the approach end of the runway. This tail catch sent the Predator tumbling down the runway and resulted in destruction of the aircraft.



M/RQ-1

Year	Class A		Class B		Destroyed		Hours
	No.	Rate	No.	Rate	A/C	Rate	
FY04	3	10.16	0	0.00	3	10.16	29,533
5 YR AVG	2.4	12.55	0.4	2.09	2.4	12.55	19,118.4
LIFETIME FY97-FY04	16	15.17	2	1.90	16	15.17	105,468

RQ-4

Year	Class A		Class B		Destroyed		Hours
	No.	Rate	No.	Rate	A/C	Rate	
FY04	0	0.00	0	0.00	0	0.00	451
LIFETIME FY00-FY04	2	95.42	0	0.00	2	95.42	2,096

Class C Mishaps

There were two mishaps involving hard landings which caused Class C damage.

One mishap occurred on the return from an operational mission, and the other occurred during a training mission. In the first, an excessive sink rate developed that was not caught prior to RPV touchdown. The porpoising and subsequent hard landing resulted in separation of the nose wheel from the nose landing gear and damage to an on-board missile by the departing wheel. The other hard landing resulted in a hard nose wheel impact and induced oscillation causing damage to the aircraft. In this instance, the pilot performed a successful go-around and landed the RPV safely despite the damage.

There was a third Class C resulting from a ground handling mishap. The aircraft was being towed when the tow bar suddenly tilted to the right due to the unstable nature of the tow bar assembly. The subsequent torquing motion caused damage to the nose wheel steering bracket.

The RQ-4 Global Hawk

A distant (and far more expensive) cousin to the Predator, the RQ-4 Global Hawk is significantly different from the RQ-1. The Predator takes direct pilot inputs, such as stick and rudder inputs, in order to fly. The Global Hawk has a ground controller who inputs command controls via a Ground Control Station, from anywhere in the world, and those controls are executed through autonomous software. The "pilot" is more there to handle contingencies. The Global Hawk had no mishaps this year, and only one reported Class E event. While on a training mission, the UAVs ruddervator flight control malfunctioned and was no longer taking inputs through the mission computer. The RQ-4 entered an auto-land mode, returned safely to base, and executed a near flawless landing to the pre-programmed runway without pilot input. Upon recovery, the chase driver from the recovery team noted the ruddervator was indeed stuck in a full-down position and the UAV was able to work around the problem and land safely.

USAF Photo by TSgt Scott Reed
Photo Illustration by Dan Harman

The QF-4 Full Scale Aerial Target (FSAT)

The QF-4 had one Class A mishap which resulted in total destruction of the FSAT, and one notable Class E event.

During the Class A mishap, the FSAT departed controlled flight during a live-fire missile evaluation. Following unsuccessful attempts to regain control of the vehicle, the destruct command was initiated. The FSAT was destroyed on ground impact.

For the Class E event, a manned QF-4 was on final turn to a full-stop landing when one of the engine generators failed. The pilot landed the aircraft to a full-stop out of the final turn, and it was discovered that the engine had flamed out.

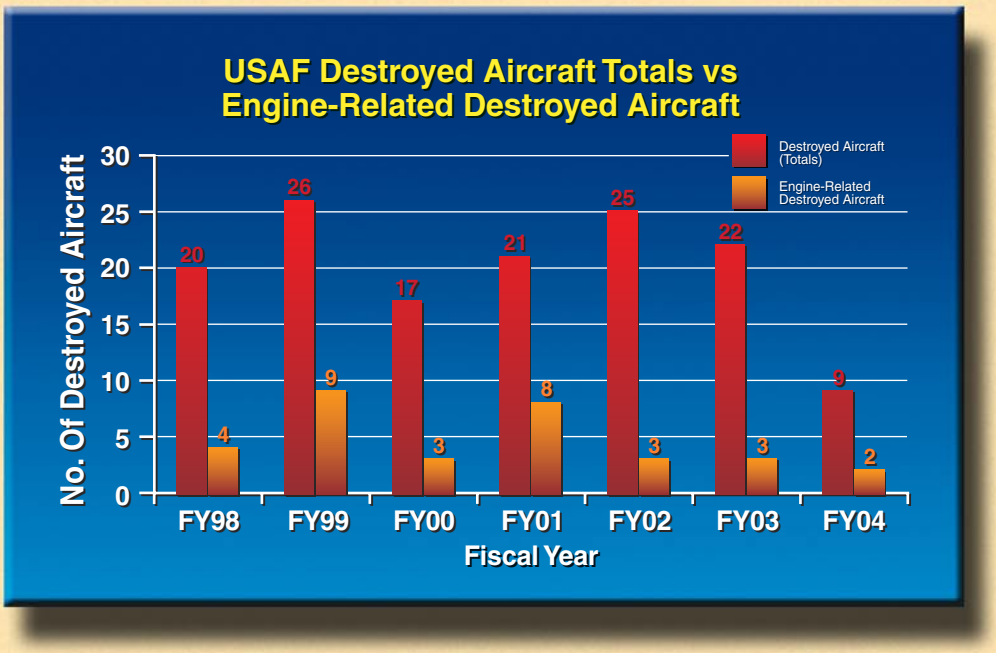
CAPT BRIAN MCDONALD
BILL BRADFORD
RICH GREENWOOD (Pratt & Whitney)
KEVIN WILSON (General Electric)
HQ AFSC/SEFE

USAF Photo by MSgt Paul Holcomb
Photo Illustration by Dan Harman

The USAF engine community has much to be proud of as we reflect on FY04. For the first time in our collective human memories and our AFSAS database (1993-present), we had fewer than three engine-related destroyed aircraft in a fiscal year. This year we lost only two aircraft with an engine malfunction and/or failure—an MH-53M and an A-10. As we will discuss later, these two mishaps were exacerbated by other contributing factors.

Figure 1 illustrates this year's engine-related destroyed aircraft success story. It compares the total number of USAF destroyed aircraft to those that were engine-related. If you do the math, the FY04 percentage of destroyed aircraft attributed to engine malfunction and/or failure increased from last year to 22 percent. However, this trend is due to the more than 50 percent overall reduction in USAF destroyed aircraft. Not only was the single-engine F-16 notably absent from this statistic, but there were no engine-related Class A mishaps in the entire USAF F-16 fleet during FY04! This was the first time in the history of the F-16 we flew through an entire fiscal year without an engine-related Class A mishap. Furthermore, the F-15 can claim an equally impressive year, since the one dollar-value Class A mishap that involved engines involved foreign object damage (FOD).

Figure 1



As much of an accomplishment as it is to lose the fewest aircraft ever, we were sadly reminded why, in the words of General Jumper, "…the goal is *zero mishaps*!" We lost five souls in the MH-53M mishap. The last time an engine-related mishap included a fatality was in 1996. Both the MH-53M mishap and the A-10 mishap are vivid examples of how independently-recoverable mechanical failures often combine to destroy aircraft and take lives. Here, we will focus on the engine as a casual factor in the mishap, as well as the factors contributing to the engine failure.

A flight of two MH-53Ms departed a deployed location in support of OPERATION ENDURING FREEDOM. According to the Accident Investigation Board (AIB) report, the mishap aircraft experienced a compressor stall of the No. 2 engine, resulting in engine failure five minutes after takeoff. Due to a high gross weight, the aircraft was unable to maintain level flight with a single engine. The crew attempted to jettison the auxiliary fuel tanks without success. They began dumping fuel as they set-up for a precautionary landing. During the landing phase, at 150-200 feet AGL, the No. 1 engine lost power and the aircraft landed at a high rate of descent on a level, rocky river bank. The helicopter subsequently hit a three-foot high embankment that severed the tail boom, then rolled left, and came to rest inverted. A post-crash fire rapidly consumed the aircraft. Four of six aircrew members and one of seven passengers were fatally injured.

During combat operations, we sometimes accept additional risk and push our systems closer to their limits. In this mishap, the power requirements of routine high gross weight flight at high altitudes were stressful even to the MH-53M's dual TF64 turboshaft engines. High operating temperatures made the engines more prone to compressor rub and subsequent compressor stall and overtemperature. When the right engine failed, the left engine was pushed well beyond its capability. It was the unfortunate simultaneous occurrence of engine failure and auxiliary fuel tank jettison system failure that brought this Pave Low down. Taken separately, these failures are recoverable.

The sequence of events leading to the second engine-related destroyed aircraft are strikingly similar to the MH-53M mishap. An A-10 was conducting a Weapons Instructor Course training mission at Nellis AFB, Nevada. While performing high angle of attack maneuvering, the No. 2 engine experienced a compressor stall and subsequent overtemperature, causing extensive heat damage to the engine. During the maneuvers, the pilot had extended the speed brakes in an attempt to make the attacking A-10 overshoot. Upon realizing he had an engine failure, the pilot began a 10-degree descent in order to maintain airspeed while attempting engine restarts and speed brake retraction. The engine would not restart and the normal and emergency speed brake retraction systems failed. Upon reaching the prescribed minimum safe ejection altitude, the pilot ejected without injury. The aircraft was destroyed on impact.

It is known that the TF34 turbofan engine on the A-10 is susceptible to airflow disturbances when flown at high angles of attack. The flight manual cautions pilots that these maneuvers, while not prohibited, can produce compressor stalls leading to engine failures. This, of course, is exactly what happened to the right engine. As noted in the MH-53M mishap, it was the unfortunate simultaneous occurrence of engine failure and speed brake retraction system failure that brought this Warthog down. To quote the AIB President's report, "If either condition had been corrected (right engine restarted or speed brakes retracted), the [mishap aircraft] would have been recoverable."

These two Class A mishaps drive home the point that we must employ particularly strong risk mitigation plans when flying engines at the fringes of their operating envelopes. In-flight compressor stalls in the fighter/attack and helicopter communities are serious events. We must not take for granted that twin engine aircraft are designed to fly home with an engine out. As shown through these examples, an engine failure can be only one failure away from unavoidable disaster.

Including these two destroyed aircraft, there was a total of 14 engine-related Class A mishaps in FY04, since 12 others surpassed the $1,000,000 cost threshold for Class A status (two of which were in test cells). Fourteen engine-related Class A mishaps were a marked increase over the six recorded in FY03 and the 10 recorded in FY02.

In an effort to explain this increase, let's look at which sections of the engine were the worst offenders. Figure 2 graphically displays the percentage breakdown of the 14 FY04 engine-related Class A mishaps. Surprisingly, one can quickly see that the "cold" sections of the engine (compressor and fan) caused half of the Class A mishaps. This bucks the historical trend of the turbine section being the major component driver of engine-related Class A mishaps. The increase from FY03 to FY04 can be explained by these two sections alone, since all other categories remained essentially constant in absolute numbers. As described earlier, both destroyed aircraft were a result of compressor stalls. The three fan-related mishaps consisted of two in-flight fan blade failures on a C-5 and a KC-10 and one test cell *domestic* object damage mishap in which a forward balance ring of an F119 engine was ingested. Risk mitigation by operators and vigilant use of inspection techniques by the maintenance community is our best front-line defense against these mishap drivers. We'll look at these mishaps in more detail later.

FY04 Engine-Related Class A Mishaps
By Engine Section

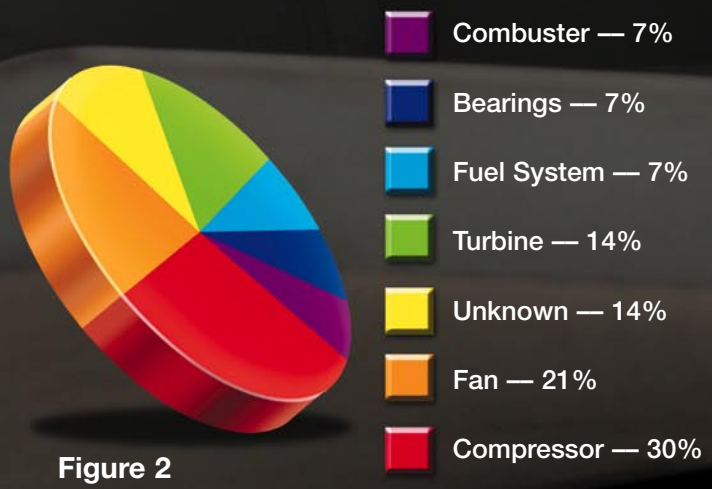


Figure 2

It is also insightful to break down the engine-related Class A mishaps by factor—logistics, maintenance, and operations. While Figure 3 shows that operations had the lowest percentage, both mishaps attributed to operations resulted in destroyed aircraft. Logistics (design, manufacturing, etc.) came in second at 29 percent. Maintenance (depot, field, and contractor) was the most common factor at 43 percent. The "unknown" category covers those factors that have not yet been determined by the safety investigation process. The percentages in Figure 3 are approximate, since the causes of some mishaps were attributed to more than one factor. Most of the maintenance-related problems were traced back to depot-level repair or overhaul processes, as opposed to simple mistakes such as a missed step in the tech order. Regardless of the final breakdown, all three communities can learn from the well-used saying that warns, "Aviation in itself is not inherently dangerous. But to an even greater degree than the sea, it is terribly unforgiving of any carelessness, incapacity or neglect."

FY04 Engine-Related Class A Mishaps
By Factor

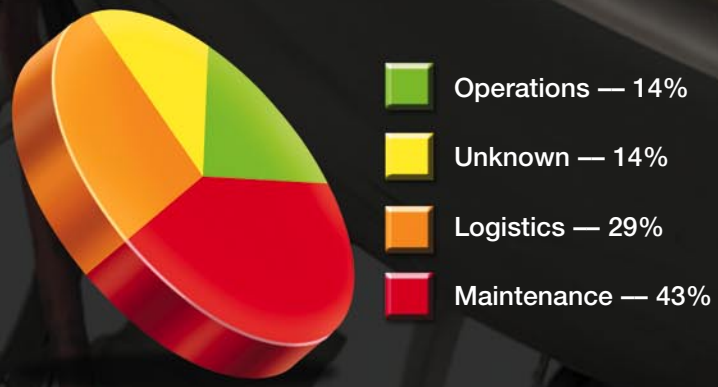


Figure 3

Fantastic Fighter Figures

Like the latest neighborhood gossip, everyone wants to know what happened with the F-16 and F-15 fleets. Well, if you skimmed past the introductory paragraph, you missed the historic declaration that there were no engine-related Class A mishaps, including no destroyed aircraft, for either airframe in FY04! Until this year, this feat of safety eluded this fighter partnership. The single-engine F-16 made this achievement possible by posting a clean record for the first time ever in FY04. We'll pass out the kudos next as we report, very briefly, on each of the airframes and engine models.

USAF Photo by SSgt Arian C. Nead
Photo Illustration by Dan Harman

F-16

Table 1 shows the F-16 engine-related destroyed aircraft and rates for the last three fiscal years by engine model. Note the two columns of zeros under the FY04 heading. Figure 4 compares engine-related Class A mishaps to all other Class A mishaps for the F-16. This is the first time in the history of the F-16 we've seen a zero on this chart! This superb accomplishment is the highest compliment that can be paid to the many organizations and their people who make these machines fly. Congratulations to the Oklahoma City Air Logistic Center (OC-ALC), the Propulsion Product Group Manager, General Electric Aircraft Engines, Pratt & Whitney, flight crews, and, of course, our maintainers, who should all be proud of their contributions to the safety of this airframe. In the past year, combat operations and other flying commitments have continued to keep the hours high for our rapidly aging aircraft, which

makes this achievement even more remarkable. Quality maintenance, inspections, and continued hardware improvements have been the cornerstone of this year's zero Class A mishap rate. Your combined pursuit of a quality product has made FY04 a truly outstanding flying year for the F100- and F110-powered F-16s.

F-16 Engine-Related Destroyed Aircraft Statistics						
Fiscal Year	FY02		FY03		FY04	
Engine	Aircraft Losses	FY02 Rate	Aircraft Losses	FY03 Rate	Aircraft Losses	FY04 Rate
F100-PW-200	0	0.00	0	0.00	0	0
F100-PW-220	0	0.00	2	1.69	0	0
F100-PW-229	0	0.00	0	0.00	0	0
F110-GE-100	1	0.61	0	0.00	0	0
F110-GE-129	1	1.87	0	0.00	0	0
All Engines	2	0.55	2	0.47	0	0

Table 1

Without diminishing the significance of the Class A accomplishment, there was an F-16/F110-GE-100 engine-related Class B mishap, which deserves some attention.

During takeoff, while in full afterburner at approximately 600 feet AGL, the pilot received a warning annunciation and saw that the engine fire light and nacelle overheat light were illuminated. However, the engine gauges showed no anomalies. Due to the overcast weather conditions, the pilot continued to climb out in full afterburner to reach a higher altitude. After reaching 5000 feet AGL, the pilot retarded the throttle to military power. Shortly afterward, the fire warning and overheat lights went out. The wingman performed a battle damage check and did not see any damage to or fire or smoke emanating from the aircraft or engine. The pilot declared an IFE and headed back to base. Engine response checks indicated no anomalies. Aircraft recovery was uneventful.

Post-flight examination of the aircraft found evidence of soot near the three- and twelve-o'clock nacelle ejector duct exits and near fasteners along the aircraft lower aft engine bay panels. Soot and blistered paint were also noted on the aft portion of the dorsal fairing and on the top of the fuselage at the base of the dorsal fairing. Subsequent teardown, analysis, and laboratory investigation revealed a detached and partially liberated augmentor fuel spraybar and indications of an engine bay fire. The fire was caused by fuel from the detached spraybar being ignited by hot core engine air. Both spraybar attachment bolts were found in the engine bay. The spraybars had been removed and reinstalled during the last engine shop visit, approximately 46 flight hours prior to the mishap.

What we take away from this mishap is the importance of closely following tech data and taking a few extra minutes to ensure the job is fully complete, even for simple or repetitive tasks. Vigilance and proper torquing procedures will prevent this type of mishap from happening again. Note also that intermittent warnings signaled a real problem. The precautionary measures taken by the pilot may have prevented a more serious mishap.

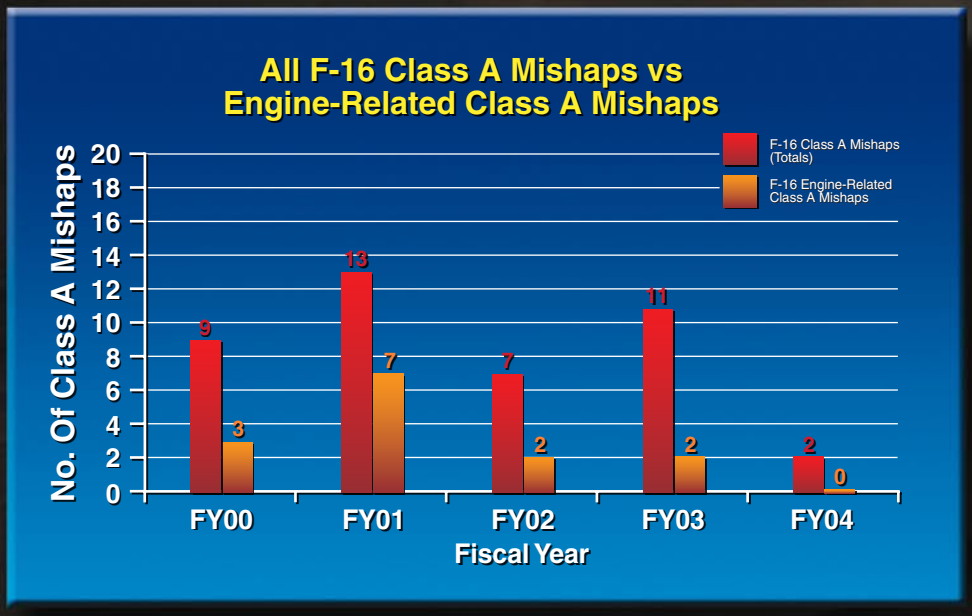


Figure 4

F-15

The F-15 engine family (F100-PW-100/220/229) continued its impressive streak of no engine-related destroyed aircraft for the sixth consecutive year. Table 2 depicts that wonderful but monotonous statistic for the past three fiscal years. As shown in Figure 5, the F-15 also notched an unblemished year in terms of engine-related Class A mishaps. Kudos, again, to all the professionals who made FY04 a very safe year for the F-15/F100 engines!

F-15 Engine-Related Destroyed Aircraft Statistics						
Fiscal Year	FY02		FY03		FY04	
Engine	Aircraft Losses	FY02 Rate	Aircraft Losses	FY03 Rate	Aircraft Losses	FY04 Rate
F100-PW-100	0	0.00	0	0.00	0	0
F100-PW-220	0	0.00	0	0.00	0	0
F100-PW-229	0	0.00	0	0.00	0	0
All Engines	0	0.00	0	0.00	0	0

Table 2

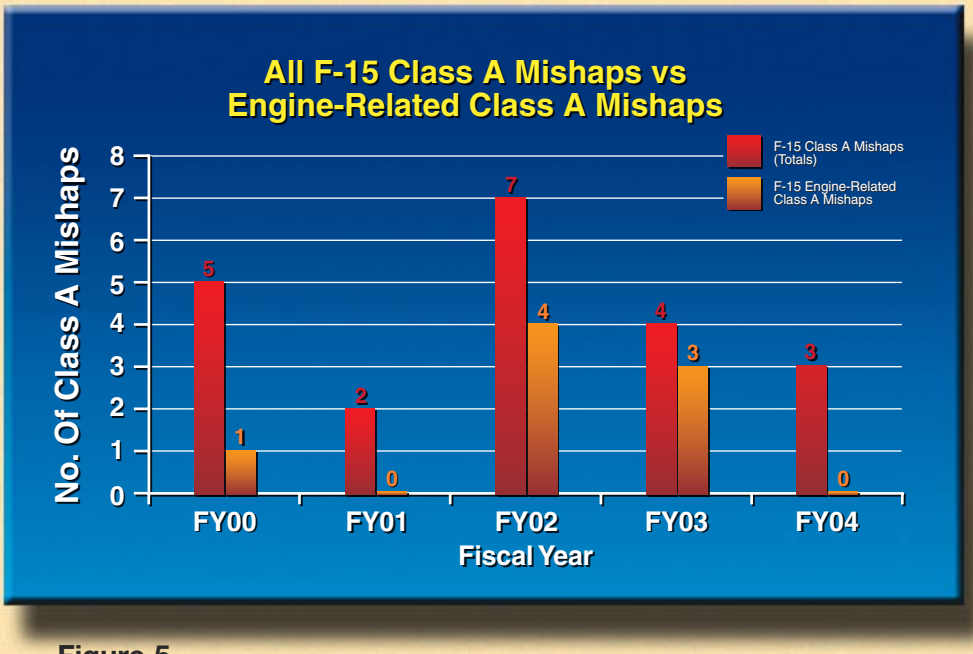


Figure 5

Other Pratt & Whitney Engines

F119-PW-100 (F/A-22)

(This information came from Part 1 of the Safety Investigation Board (SIB) report, which is not privileged.)

Our newest fighter engine was involved in three engine-related mishaps this year—one Class A inside a ground test cell at Arnold AFB and two Class Bs on flight test aircraft from Edwards AFB. We'll only discuss the Class A mishap here.

The engine was being run as part of an accelerated mission test. During testing, the test crew noted that engine vibration levels were above desired levels. In an attempt to reduce vibration levels, they shut down the engine and made an adjustment to the forward fan balance ring. During the next start, as the engine approached idle, they noticed sparks coming out of the engine exhaust. The test director immediately directed engine shutdown.

The ensuing examination found extensive damage to the fan and high pressure compressor airfoils aft of the inlet guide vanes. The forward fan balance ring was no longer in place. Remains of the forward balance ring were recovered from inside the engine and analyzed. No balance ring material flaws were found and all undamaged fracture surfaces showed only fresh overstress.

It was determined that the engine damage was due to the ingestion of the forward balance ring.

F117-PW-100 (C-17)

The F117-PW-100 engine used on the C-17 transport tentatively suffered three engine-related, dollar-value Class A mishaps in FY04.

The first mishap occurred during cruise flight. The oil temperature and pressure began to steadily rise on the No. 1 engine, followed by a compressor stall, and reduction in performance. "Oil Filter 1" then annunciated on the cockpit Warning Annunciation Panel (WAP). The crew retarded the throttle to idle and ran the corresponding checklist, which directed a precautionary shutdown of the engine. The crew flew a normal approach and three-engine landing.

Teardown of the engine revealed a failure of the No. 3 bearing in the No. 1 engine. Due to extensive damage, the exact cause of the bearing failure could not be determined; however, a statistical analysis of this and other bearing events indicate it was a "random" failure mode. Improvements to the Joint Oil Analysis Program (JOAP) and chip detector inspection practices are being considered as risk mitigating actions.

The second in-flight mishap began when sparks were noticed in the No. 3 engine inlet of a C-17. However, no anomalies were indicated on the cockpit engine display. The crew initiated a divert to an alternate airfield. Upon level-off at 5000 feet, the loadmaster noticed a reoccurrence of sparking from the same engine. Abeam the alternate airfield, the crew heard a loud pop, the aircraft yawed slightly, and the loadmaster saw a flash from the back of the No. 3 engine. Cockpit displays indicated an engine failure. Subsequently, the crew shut down the engine, declared an emergency, and accomplished an uneventful three-engine approach and landing. The engine was shipped for investigation and analysis.

Teardown of the engine showed the incident was due to fracture of a 10th stage compressor stator vane, a known problem on the C-17/F117 fleet. A newly-designed cast and damped stator is being introduced to the fleet with a scheduled retrofit completion date of December 2007.

At the time of this writing, the third mishap was still under investigation and may be downgraded, pending final cost estimates. The C-17 was diverting due to various WAP cues on the No. 4 engine, including multiple electronic engine control messages and momentary high exhaust gas temperature. On final approach, the tower saw flames coming from the No. 4 engine. The fire department extinguished the remaining fire after the C-17 had landed. The initial inspection of the engine by maintenance personnel revealed no exterior engine damage.

TF33-PW-102 (KC-135E)

The large, and aging, TF33 fleet suffered only one dollar-value Class A mishap this fiscal year. According to the AIB report, a TF33-PW-102-powered KC-135E had just departed for an aerial refueling mission with two C-17s when the aircrew heard a loud bang and observed loss of thrust on the No. 3 engine. After jettisoning fuel, the aircrew made an uneventful landing back at home base. In addition to extensive damage to the engine, collateral damage was also found on the airframe from uncontained engine hardware.

Engine disassembly and metallurgical examination by Pratt & Whitney and the Oklahoma City Air Logistics Center determined that the root cause of the failure was a fatigue crack of the front flange weld of the first stage turbine nozzle stator support. The investigation determined that, most likely, at some time in the repair history of the part, it had been subjected to an improper heat treatment that caused the flange to soften and fatigue. Because the support was not a tracked item, it could not be determined exactly where, when, or how many times the part had been repaired. The AIB found ambiguous technical order procedures for the repair process. Corrective actions implemented to keep this failure mode from reoccurring include clarification of the repair procedures and a hardness check of the flange when the part is inspected at the depot.

Other General Electric Engines

F103-GE-100 (E-4B)

An F103-GE-100 engine-related dollar-value Class A mishap occurred during an operational E-4B mission. Departure was routine until nine minutes after takeoff, when the crew noticed the No. 4 engine exhaust gas temperature (EGT) caution light illuminate. The light was accompanied by a high EGT reading, high fuel flow, and heavy vibration. The pilot reduced the No. 4 engine to idle, after which EGT and fuel flow decreased; however, the vibration remained. The crew shut down the engine and made an uneventful landing.

Post-flight inspection revealed metal in the tailpipe of the No. 4 engine. The engine was removed and borescoped. The inspection identified damage to the high and low pressure turbines. The ultimate cause was later found to be the release of a second stage high pressure turbine (HPT) blade into the engine flow path. The blade release was determined to be a result of intergranular oxidation (IGO) cracks in the blade shank. The configuration of the failed blade was a pre-product improvement program (PIP) blade with a known propensity for IGO cracking. PIP blades are more resistant to IGO due to protective coatings on the internal cooling passages. A program to actively replace the pre-PIP blades with PIP blades will reduce the risk associated with this problem.

F103-GE-101 (KC-10)

There were two dollar-value Class A mishaps in the F103-GE-101 (KC-10) engine fleet in FY04. The first mishap occurred when the aircraft was on takeoff roll at 60 knots with all engines at 110-percent fan speed. Two seconds into aircraft rotation, the aircrew reported hearing a loud noise and felt the aircraft shudder and yaw to the right. The Flight Engineer noted the fan and core speed drop on the No. 3 engine. While climbing out, the crew shut down the No. 3 engine. After climbing to 3000 feet and dumping fuel to reach a safe landing weight, the aircraft made an uneventful landing.

During post-flight inspection, a portion of a low pressure turbine (LPT) blade was found in the exhaust duct of the No. 3 engine. A borescope inspection of the engine revealed damage from the first stage of the HPT aft through the LPT section. Subsequent teardown, analysis, and laboratory investigation failed to find the root cause of the event due to the poor/damaged condition of the hardware. Therefore, this was tallied as one of the two "unknowns" in Figure 2. Evidence indicated that the primary damage occurred in the first stage HPT region, most likely from a liberated HPT blade or dropped shroud segment(s). Field actions were already underway prior to the mishap for the introduction of improved (internally coated) first stage HPT blades and discontinued use of repaired HPT shroud segments as spares.

The second KC-10/F103-GE-101 engine-related mishap occurred during an air refueling training mission. Approximately four hours into the mission, during a practice emergency breakaway maneuver and after advancing the throttles to maximum continuous thrust, the flight crew reported feeling a bump and a severe vibration throughout the aircraft. All engine instruments were normal. The receiver aircraft (C-5) and the boom operator reported sparks coming from both the inlet and exhaust of the No. 2 engine. The flight crew brought the No. 2 engine throttle to idle and noticed a decrease in the vibration level. At the same time, several thrust reverser caution lights

illuminated. They subsequently shut down the No. 2 engine. A hydraulic leak in the No. 2 engine system was noticed, and measures were taken to stop the leak. An IFE was declared, the aircraft returned to base, and landed uneventfully.

Ground inspection of the No. 2 engine revealed that a portion of a first-stage fan blade had fractured and been ingested by the engine. Laboratory analysis of the failed fan blade determined that a fatigue crack propagated forward from an anomaly at the trailing edge of the blade. Engine records showed that the blade had been through a repair and reconditioning cycle at a blade repair facility 1,227 cycles prior to the mishap. Field actions, in the form of eddy current inspections, are planned for blades processed by this repair facility. The repair shop has since eliminated several suspect reconditioning processes and incorporated enhanced inspections of the blades.

TF39-GE-1C (C-5B)

The other in-flight fan blade failure occurred on a TF39-GE-1C engine on a C-5B aircraft. Climbout was normal until shortly after reaching cruise altitude. At 33,000 feet, the crew saw a bright light and sparks coming from the No. 4 engine. The crew elected to shut down the engine and perform an emergency landing.

Post-flight inspection revealed a hole in the side of the No. 4 engine nacelle, impact damage to the under-wing, and damage to the adjacent No. 3 engine nacelle. Extensive damage to the fan was found, with one second stage fan blade missing its outer panel. Metallurgical analysis of the blade determined that a fatigue crack propagated forward from the trailing edge of the blade, just above the mid-span shroud. In response to this mishap, field maintenance conducted a one-time borescope inspection of suspect TF39-GE-1C fan blades and instituted a recurring eddy current inspection of fan blade trailing edges.

F101-GE-102 (B-1B)

The F101 engine fleet has recently suffered a rash of Class B mishaps due to blade creep in the turbine section. One of those mishaps occurred on a B-1B launched as a single-ship combat sortie from a forward operating location. The sortie was uneventful from pre-flight through the last air-refueling. One hour later, the crew heard a loud bang and felt the aircraft shudder. The No. 2 engine "Vibe High" caution light illuminated, causing the pilot to immediately retard the No. 2 throttle to idle power. Seconds later, the same caution light illuminated again. The crew shut down the No. 2 engine, declared an IFE, and landed uneventfully. A post-flight visual inspection by maintenance found extensive damage to the LPT section of the No. 2 engine. The engine was removed from the aircraft and shipped to the Engine Regional Repair Center.

Teardown inspection revealed one broken first stage LPT blade and significant damage downstream. There was another first stage LPT blade cracked at its mid-span. All first stage LPT blades showed signs of "necking," which is indicative of the onset of stress rupture (creep). The OC-ALC Materials Laboratory produced a short video to explain this phenomenon, as well as a solution, in a succinct and very eye-pleasing way. Take a look at https://wwwmil.tinker.af.mil/mad/OrgWeb/MADL/MADLM/MADLM.html. (Access limited to .mil domain only.)

Investigation to date has revealed two key contributing factors to this blade creep problem: mission severity and blade age. The mission profile being flown at the deployed location has a severity factor approximately 11 times that observed during the last mission analysis completed in late 1997. Current combat missions are much longer, with heavier takeoff and cruise weights. As a result, the engine operates at increased temperatures for prolonged periods, which more rapidly consumes the stress rupture life of the LPT blades. In an effort to prevent additional events, OC-ALC engineering is recommending a TCTO to borescope inspect first stage LPT blades for evidence of creep. This same inspection will be added to the 100-hour special inspection and 600 EFH phase cards. There is also an effort underway to institute a step-down plan to remove high time first-stage LPT blades, which will address the second contributing factor—blade age. A longer term action involves a blade material change to a more creep-tolerant material. Again, watch that Materials Lab video for more!

Dietary Needs Of Jet Engines

We proved several more times that engines dislike the taste of foreign objects, including rocks and birds. There was one C-17 Class A FOD mishap, plus the previously mentioned F-15 FOD mishap, for a total of two Class A FOD mishaps in FY04. All four engines on the C-17 ingested loose gravel from the end of the runway and sides of the taxiway during use of reverse thrust. These expensive mishaps reinforce the need to be ever vigilant about this persistent nemesis. Bird strikes to engines accounted for two more Class A mishaps—destruction of an F-15E aircraft and damage to three engines on an MC-130P. A single black vulture was to blame for the loss of the F-15E. A large flock of pigeons was thinned-out by the MC-130P. Sixty-six carcasses were recovered from the runway. At press time, the MC-130P bird strike mishap was still under investigation and could be downgraded. None of these mishaps were included in the engine-related statistics. Please keep your engines on a strict diet of fresh air!

Summary

We've pumped our fists and handed out a lot of well-deserved kudos because we achieved two noteworthy historical firsts in the safety of military aircraft engines—the fewest number of engine-related destroyed aircraft and zero F-16 engine-related Class A mishaps. We must not rest on our laurels and let this year be an anomaly. Clearly, the next major milestone for the engine community is zero destroyed aircraft. We almost did it this year. An additional challenge is reducing the far less publicized, but far too common, Class B mishaps that insidiously consume our resources and degrade our warfighting capability. Engines are, by far, the leading contributor to Class B mishaps. With continued concerted effort, we can drive those statistics down as we have with Class A mishaps. Be safe!

FY05 Flight Mishaps (Oct 04-Jan 05)

8 Class A Mishaps
1 Fatality
3 Aircraft Destroyed

FY04 Flight Mishaps (Oct 03-Jan 04)

6 Class A Mishaps
4 Fatalities
3 Aircraft Destroyed

03 Oct		A C-5B sustained damage to 2 engines after multiple bird strikes.
04 Oct		Two F-15Cs collided in midair; both returned to base OK.
13 Oct	✶	An MQ-1L experienced a hard landing.
18 Oct		An F-16C tire tread separated on takeoff; barrier was engaged and gear collapsed.
20 Oct	✈	An HH-60G crashed during a rescue mission; 1 fatality and 5 injuries.
27 Oct		A KC-10 had a #3 engine failure.
24 Nov	✶	An MQ-1L crashed during an FCF.
30 Nov		A B-1B had an inflight fire in the aircraft equipment bay.
14 Dec	✶	A B-1B nose gear collasped after landing.
20 Dec	✈	An F/A-22 crashed immediately after takeoff.
29 Dec	✈	An MC-130H impacted a hole in the runway on landing.

Editor's note: 07 Oct B-2 engine failure, 04 Nov F-15 runway mishap and 09 Nov F-15 engine fire have all been changed to Class B mishaps.

- 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://afsafety.af.mil/AFSC/RDBMS/Flight/stats/statspage.html.
- **Current as of 12 Jan 05**.

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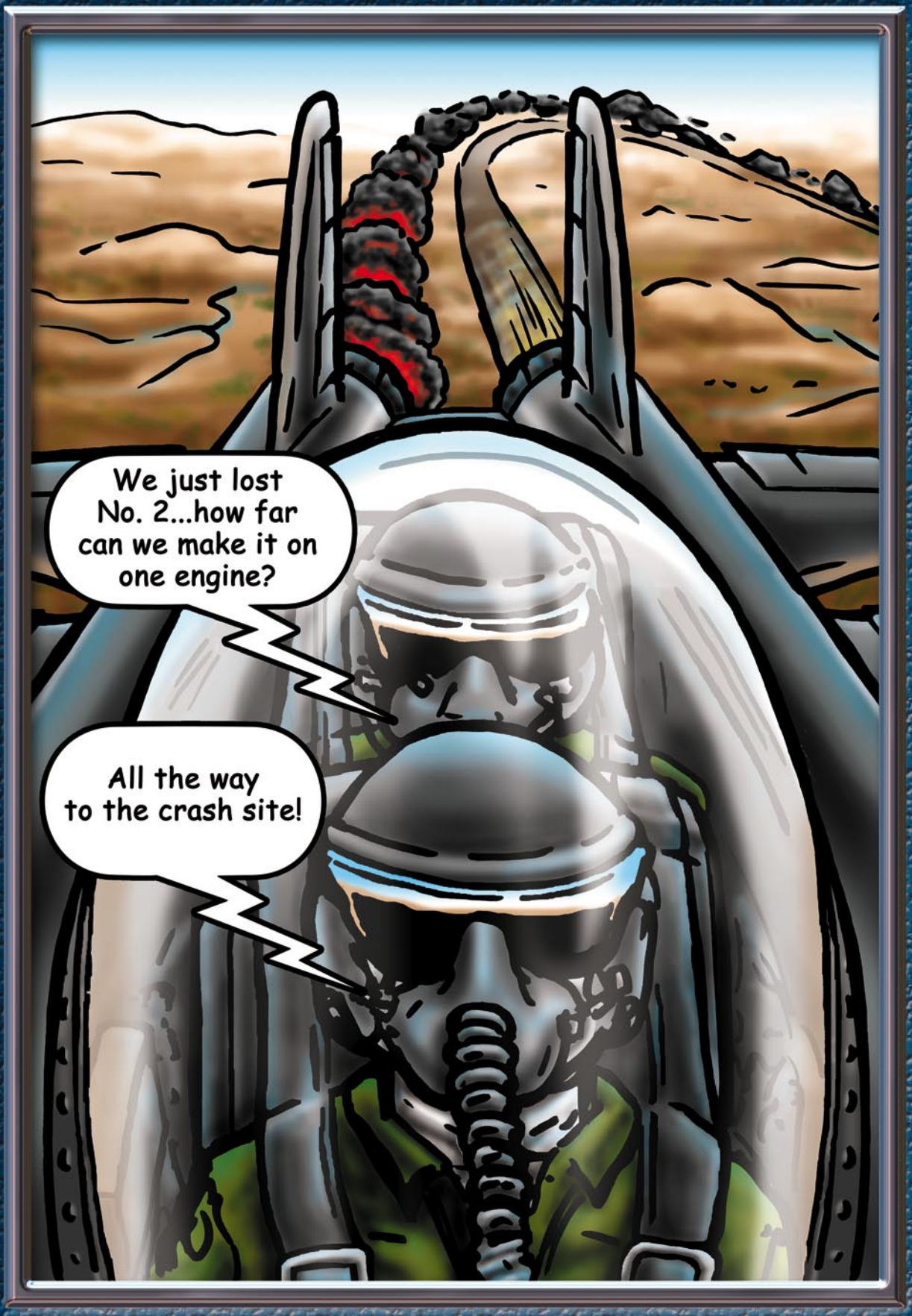
We just lost No. 2...how far can we make it on one engine?
All the way to the crash site!