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2005 Year in Review

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Editor's Note: FY05 flying hours in charts are forecast for September.

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MESSAGE FROM THE CHIEF of SAFETY

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As we near the halfway point in FY06, the Air Force continues to enjoy success in conducting global operations in support of our nation's national security objectives. The task of conducting these operations safely and effectively remains a top priority. So far in FY06, the total number of destroyed aircraft is down compared to the same period last year, but the overall number of Class A and Class B mishaps is on the rise. This trend renews the challenge of looking back on FY05 and drawing upon the lessons we should have learned and applied.

The FY05 mishap trend was mixed; we achieved some mishap prevention success and worked our challenges hard. While flying over 2.14 million hours in FY05, the Air Force experienced 14 aviation-related fatalities, down one from last year, and well below the 10-year average. Destroyed aircraft remained the same: 11 aircraft at an estimated cost of $667.1 million, again well below the 10-year average.

Our Airmen and equipment represent the foundation of our combat capability! We need to make sure the accepted risk in employing them is worth the effects they produce. The Air Force experienced 32 overall Class A Flight mishaps in FY05. This equated to a rising Class A mishap rate (mishaps per 100,000 flying hours) of 1.49, compared to 1.18 in FY04. While there was only a small increase in the fighter/attack mishap rate, we experienced a large increase in the helicopter mishap rate. The positive trend in aviation-related fatalities was a highlight, but the loss of even one Airman is always one too many. We need to continue working this and the rest of our challenges harder.

Secretary Rumsfeld challenged us in FY03 to reduce the number and rate of mishaps by 50% in two years. That deadline has passed and we frankly missed the mark. We continue to see poor decisions, both on the part of operators and maintainers, and a breakdown in basic skills prevalent in our mishaps. Making proper risk decisions is a challenge Airmen and their commanders face every day. In some instances accepting a "high" level of risk is warranted, but this *cannot* become the norm. Commanders must always weigh the cost/benefit of accepting increased risk. While the decision to delay, modify, or cancel a mission may be unpopular, it may be necessary to preserve overall combat capability and achieve broader effects.

As individuals, we must be aware of the level of risk we can accept, and if we do identify a "higher" risk, it is our responsibility to pass it up the chain of command so that the risk decision can be made at the appropriate level. Additionally, time-critical ORM must become a standard tool all Airmen use. Operations rarely occur exactly as planned. If changes to a mission or task present themselves, we must re-evaluate the situation to ensure the risk we are undertaking is being properly accepted.

We can transform challenge into success over the remainder of FY06 if we apply increased discipline and solid risk management in accomplishing all aspects of our mission. Every destroyed aircraft and every fatality is a lost combat asset. As the global war on terrorism and our commitment to worldwide operations continue, we must do all we can to preserve valuable combat capability through diligent preparation and attention to detail.

We are not looking for the minimum risk; we are looking for the right risk.

Fly Safe. ★★

MAJOR GENERAL LEE MCFANN, USAF
Chief of Safety

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

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Bombers

MAJ RANDY RUSHWORTH
HQ AFSC/SEFF

The bomber community continued the fine legacy of supporting worldwide combat operations and expanding operational capabilities in FY05 while successfully managing a capable, yet aging, force structure. There were six total Class A mishaps in the community during FY05, up from a single Class A in FY04. The total of 21 community-wide Class B mishaps was also an increase over FY04. Engine-related mishaps continued to be the focal point for FY05; engines were a significant factor in all three bomber weapon system mishap statistics. Of particular note was an increase in the number of reported maintenance mishaps resulting in personal injury and/or damage to aircraft, all avoidable through pre-established procedures and safety practices.

FY05 B-1B Safety Review

The B-1 community had a challenging year in FY05. The B-1 experienced four Class A, 12 Class B, and 29 Class C mishaps, all mishap class totals greater than FY04. An additional total of 106 Class E events were reported throughout FY05, including 50 propulsion-related and 49 BASH-related events. FY05 marks the third consecutive year the B-1 community experienced a rise in mishaps and events, a majority of which were related to engines/propulsion.

Class A Mishaps

Of the four B-1 Class A mishaps, two involved aircraft fires, one involved a nose landing gear collapse, and one involved inflight engine damage. One fire resulted from a short circuit in a 230VAC bus wire which compromised a coolant line, igniting the escaping coolant and causing fire damage to the aft equipment bay. Investigation revealed that the involved wire bundle in the aft equipment bay was installed without adequate semi-rigid Teflon spiral wrap chafe guard. Hardware modifications are being directed to all B-1 aircraft to ensure safe clearance between wire bundles, fluid lines and mounting brackets in the aft equipment bay.

USAF Photo by TSgt Timothy Coleman

The B-1 landing gear mishap occurred after the "nose gear down and locked" light remained illuminated during gear retraction after takeoff. The light was accompanied by a CITS NLG STRUT message and prompted the aircrew to accomplish Section III procedures, dump fuel and fly a visual straight-in, first to a low approach and then to a full-stop landing. The aircrew did not declare an emergency, and normal SOF checklists were not accomplished, including Top 3 notification. The aircrew taxied the aircraft to parking and shut down normally. The landing gear safety pins were not installed, and upon No. 1 engine shutdown, the nose gear collapsed. The nose gear strut selector and emergency dump valve were found to be improperly assembled back in 2001 and put into the supply system. The aircrew, electing not to declare an inflight emergency, prevented the ground and emergency crews from taking actions which would have mitigated damage to the aircraft by pinning the nose gear. T.O. 1B-1B-1 and T.O. 1B-1B-1CL-1 were amended to require the nose landing gear safety pin to be installed following any airborne landing gear malfunction, and depot action items were validated to preclude improperly assembled valves from entering or remaining in the supply system.

The B-1 engine-related Class A mishap involved an inflight failure of three variable stator vanes to move to their commanded positions, creating a one-per-revolution disruption of airflow to the second-stage compressor blades. This airflow disruption caused fatigue cracking which propagated in two of the second-stage compressor blades near their disk post interfaces, as well as cracks in the No. 1 and 2 compressor spools. One of the affected second-stage compressor blades broke at the disk post interface and was liberated, causing catastrophic damage to the engine. The B-1 community is continuing to investigate for other potential one-per-revolution airflow disruption sources in the F101 engine.

The final B-1 Class A mishap of FY05 involved a main landing gear hydraulic fire on landing rollout. Excessive lateral movement of the torque tube/brake assembly caused failure of the No. 2 hydraulic system brake swivel link and contact between the No. 5 wheel and brake assembly. Sparks from the contact between the No. 5 wheel and brake assembly ignited the high-pressure hydraulic fluid leak from the failed No. 2 hydraulic brake swivel link. The heat from the ensuing fire ruptured a No. 3 hydraulic system line, leaking additional hydraulic fluid under high pressure and intensifying the fire. The aircrew exited the runway, shut down the aircraft and performed emergency ground egress. The responding fire department extinguished the fire 16 minutes and 30 seconds after initial notification. The total cost of this mishap exceeded 32 million dollars. Engineering review, revised TCTO guidance, and improved inspection criteria are being accomplished for the axle beam bushing and torque tube/brake assemblies on all B-1 aircraft, as well as increased alert posture for fire departments during aircraft transition.

Class B Mishaps

Of the 12 B-1 Class Bs, 10 were engine/propulsion-related, one involved hot brakes, and one involved damage to a radome and horizontal stabilizer. The propulsion-related Class Bs had a variety of causes, including bearing failures, LPT blade failures, compressor stalls, fuel control failures, and lost oil pressure. The one continuing Class B trend from FY03 and FY04 was the LPT fan blade failures. The Class B involving hot brakes resulted from a commanded high-speed abort for a non-safety-of-flight item. Maximum braking procedures were applied, which brought the aircraft to a stop with 3000 feet of usable runway left. The aircraft was taxied for over 4000 feet with the brake temperature in excess of 900 degrees Fahrenheit. The aircrew stopped the aircraft on the approach-end hot brakes inspection area and emergency ground-egressed without injury. The No. 8 wheel subsequently failed, allowing the tire to separate and severing the brake hydraulic lines. The leaking hydraulic fluid caught fire in the left main landing gear area and was extinguished by the responding fire department. This mishap could have easily become the fifth B-1 Class A for FY05. The total cost for this mishap was just over $962,000.

The remaining B-1 Class B mishap occurred at the conclusion of an aircraft tow. The aircraft was finished with initial programmed depot maintenance (PDM) and was accomplishing post-PDM ground and flight checks. After the tow, the aircraft was parked. The chocks failed to hold the aircraft in place and it began to roll backwards, striking a blast fence behind the parking spot. Investigation revealed a deviation from technical data by the tow team in using the alternate towing procedure and the unauthorized use of urethane chocks to park the B-1.

Class C and E Mishap/Events

The B-1 experienced 29 Class C mishaps in FY05, one more than in FY04. Fifteen of these mishaps involved damage to engines, including FOD, constant speed drives and LPT damage. An intermediate weapons bay door was closed on a ladder, and an aircraft was towed into a hangar door, accounting for two more Class Cs. The remaining Class C mishaps involved various structural damage and personnel injury. There were 106 Class E events in the B-1 community, including 50 propulsion-related events and 49 BASH-related events, as compared with 52 propulsion and 37 BASH events in FY04. One flight control-related Class E and two HATRs accounted for the remaining notable Class E events.

FY05 B-2 Safety Review

The B-2 community completed yet another year with a positive trend in preventing Class A mishaps. Three FY05 Class B mishaps and eight Class C mishaps for the B-2, however, was an increase from FY04 and highlighted the importance of increased mishap prevention focus as the community continues to expand its operational scope.

Class B Mishaps

The B-2 community experienced three Class B mishaps in FY05. The first Class B involved an engine failure on takeoff that resulted from an axial load applied to the main engine control (MEC) driveshaft, most likely during driveshaft installation, which damaged the shaft retaining pin, eventually causing the MEC to break contact with the engine-driven fuel pump. The resulting engine over-speed and over-temp caused severe damage to the turbine

USAF Photo by TSgt Cecilio Ricardo

section. The MEC driveshaft is being re-evaluated by the Component Improvement Program for a future redesign to reduce the risk of damage to the driveshaft during installation and operation.

The second B-2 Class B mishap involved damage to the No. 3 engine tailpipe and exhaust nozzle bay, and could not be conclusively tied to a specific point in time, flight or maintenance activity. The mishap aircraft had the most airframe hours of any B-2 in the fleet and had flown almost half of the design lifetime airframe hours specified for the B-2 program. The manufacturer had pre-identified the exhaust bay's susceptibility to high temperatures and an engine configuration susceptible to flow reversals and "flash" events during engine start. A faulty design of the engine accumulator drain system allowed combustible fluids to be deposited into the exhaust bay. Over time, exhaust bay temperatures deteriorated E-foam in the No. 3 engine exhaust bay, and transformed the accumulated combustible fluids into a vapor state during aircraft operations. During an engine re-start on the ground, a "flash" event ignited the fluid vapors, resulting in a fire in the No. 3 engine exhaust bay. Maintenance personnel discovered the damage during a scheduled removal of the engine tailpipe. Improved risk mitigation control measures and removal of E-foam from portions of all engine exhaust bays were implemented to reduce the hazard to the rest of the B-2 fleet.

The third and final B-2 Class B mishap of FY05 involved damage to first-stage engine fan blades and approximately 100 additional compressor blades caused by the liberation of a portion of one first-stage fan blade. The mishap aircraft descended into an area of potential induction icing associated with a stationary front producing rain, thunderstorms and occasional unforecast rime icing. The damaged fan blades were the result of a known design deficiency of the B-2 engine inlet and icing that formed on the interior surface of the engine inlet, which subsequently broke off and was ingested by the engine. The aircrew received no abnormal indications of engine performance, and the damage was discovered during post-flight maintenance. Two engineering modifications are in progress to limit/prevent ice formation on the engine inlet, and to limit the damage to the engine first-stage compressor when ice does form.

Class C and E Mishaps/Events

Of the eight B-2 Class C mishaps, two involved bird strike damage, one involved static discharge damage, two involved component damage during ground operations, one turbulence encounter, and the remaining two involved inflight component failures. There were 66 B-2 Class E events in FY05. Three involved propulsion and 59 involved BASH events.

FY05 B-52 Safety Review

The B-52 community experienced two Class A, six Class B, and 17 Class C mishaps in FY05. Class As were up from zero in FY04, Class Bs were up from four, and Class Cs were down from 22 in FY04. Continued effective reporting and hazard identification resulted in 169 Class E events, down from 183 in FY04, including 59 engine-related Class Es and 98 BASH-related Class Es.

Class A Mishaps

The first B-52 Class A of FY05 resulted from a lightning strike on the nose radome during descent to the local area. The lightning protection system failed to divert all the strike energy, allowing a significant amount of energy to arc into the nose, igniting the radar absorbent material (RAM) and starting a fire. The lightning protection system failure was most likely due to changes made in the nose radome and electronic countermeasures (ECM) equipment rack for the integration of the AN/ALQ-172(V)2 system. The severity of the deteriorating weather en route to the local area and during the descent was also not adequately assessed by the aircrew or SOF, allowing the aircraft to fly through conditions where lightning strikes are prevalent. Weather avoidance training for aircrews was highlighted, and improved training and oversight of the SOF program was recommended, as

USAF Photo by SSgt Denise A. Rayder

well as changes to the lightning protection system including fire retardant radio frequency absorbing material in the nose radome.

The second B-52 Class A involved damage to the seeker head of an AGM-129 missile during a flight test mission for the Avionics Midlife Improvement (AMI) program. An incorrect engineering assessment of Laser Doppler Velocimeter (LDV) operations resulted in the use of a standard pylon configuration for the regression test of new software instead of a plus-count pylon which provides necessary cooling air when operating the LDV. Cooling requirements were overlooked when new mission test cards were created using the incorrect LDV engineering assessment. Twenty minutes after a simulated launch of the AGM-129 missile mounted on the standard pylon, control personnel detected intermittent indication of uncooled LDV operations Fifty-eight minutes after the simulated launch, control personnel elected to shut down the missile. An improved risk mitigation plan was put in place to prevent the forwarding and use of inaccurate technical information during test mission development and execution.

Class B Mishaps

Five of the six B-52 Class B mishaps involved engine damage due to various reasons, including FOD, loss of oil pressure, carbon seals, and a liberated counterweight. The remaining Class B involved damage to an inboard flap segment while raising the flaps for an engine run.

Maintenance personnel notified the B-52 SPO that they had found five aircraft with loose flap drive screw trunnion bushings and trunnion bolts. The maintenance group requested engineering assistance and disposition instructions. The SPO asked for an inspection of all aircraft in PDM to determine if the trunnion bushing inspection was being performed properly. The trunnion bushing inspections were previously “signed off” as complete for the mishap aircraft (MA) during the “in-dock” phase of PDM. The MA was the fourth PDM aircraft rechecked. On the other PDM aircraft, mechanics found numerous loose trunnion bolts. The inspection for each aircraft included removing the flap drive screws, two per flap, for a total of eight drive screws. During a re-inspection of the eventual Class B MA, aircraft mechanics removed flap drive screws No. 4 and No. 5, one each for both inboard flaps, and performed the inspection, finding one bushing hole for each flap screw too large for the bushing. The mechanics then contacted machinists to manufacture oversize bushings. Manufacturing the bushings normally takes longer than one shift; therefore, the oversized bushings were not expected until the next day. The next day an aircraft mechanic received the bushings just before the end of the shift, and elected to leave them in the shop office for the next shift to reinstall. Due to a lack of qualified mechanics on subsequent shifts, the bushings and flap screws were not reinstalled. Two days later, an engine-run crew was dispatched to the MA to complete the post-PDM engine operational test run. They completed the pre-engine-run FO checklist and began the engine-run checklist. As required by the checklist, the ground crew member cleared the cockpit crewmembers to raise the flaps prior to starting the engines. The ground member heard a loud noise as the flaps retracted and then observed the inboard flaps in an asymmetrical configuration. He immediately directed the cockpit crewmembers to terminate the flap retraction. Upon investigation, the ground member discovered one flap drive screw was missing on each inboard flap and observed significant damage to the flaps. The engine-run crew stopped all further actions and notified the maintenance control center of the incident. Several recommendations were made to improve communication between maintenance shifts in-dock and post-dock to effectively document incomplete maintenance actions.

Class C and Class E Mishaps/Events

Of the 17 B-52 Class C mishaps in FY05, only three were engine-related. The remaining mishaps highlighted the need for increased vigilance and safety practice on the flightline and in maintenance areas. Three mishaps resulted in injury to maintenance personnel, and five mishaps involved maintenance personnel moving/driving ground equipment into aircraft and/or towing aircraft into contact with structures or ground equipment. All of these mishaps had a common theme in either bypassing and/or disregarding established safety procedures. The 169 Class E events for FY05 were an indication of increased focus on reporting and addressing hazards before they became more serious mishaps. The 98 FY05 BASH-related events were down from 139 in FY04, and the 59 engine-related Class E events were up from 39 in FY04.

Summary

The mishaps and statistics for FY05 highlight the need for the bomber community to continue to focus on sound operational risk management and institutionalize safety practices and procedures. Bombers remain the crown jewel of broad spectrum combat capability within the Air Force, but their continuing impact to the mission depends on vigilance and care in preserving irreplaceable assets. The maturing safety culture in the bomber community is, and will continue to be, every bit as vital as the capability to create effects and put weapons on target…they are sides of the same coin.

B-1

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	5	18.00	9	32.40	0	0.00	0	0	27,776
5 YR AVG	1.8	7.07	8.2	32.21	0.2	0.79	0.0	0.0	25,460.2
10 YR AVG	1.1	4.40	5.4	21.62	0.3	1.20	0.2	0.4	24,980.5
LIFETIME CY84-FY05	21	4.45	65	13.78	7	1.48	6	11	471,748

B-2

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	0	0.00	3	46.01	0	0.00	0	0	6,520
5 YR AVG	0	0.00	1	17.97	0	0.00	0	0	6,676
10 YR AVG	0	0.00	1	13.09	0	0.00	0	0	5,349
LIFETIME FY90-FY05	0	0.00	7	12.07	0	0.00	0	0	57,991

B-52

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	1	4.39	3	13.16	0	0.00	0	0	22,790
5 YR AVG	0.2	0.78	2.6	10.13	0.0	0.00	0.0	0.0	25,667.8
10 YR AVG	0.1	0.41	1.9	7.81	0.0	0.00	0.0	0.0	24,318.7
LIFETIME CY55-FY05	98	1.28	183	2.39	76	0.99	99	315	7,641,807

Note: These charts reflect flight-only mishaps, not all flight-related mishaps.

A-10

USAF Photo by MSgt Dale Atkins

LT COL JOERG BEHNKE
German Air Force
HQ AFSC/SEFF

Overall, the A-10 community had a great year when looking at Class A mishaps. In the mighty Warthog community we had no loss of life, no destroyed aircraft, and no Class A mishaps. The men and women maintaining and operating the A-10 are to be congratulated on their efforts. To find the most recent year in which there were no Class A's you have to go back to CY76. Keep in mind, though, in 1976 only 3678 hours were flown as compared to the 118,601 hours flown in FY05. This is an outstanding result!

However, when we look at the other classes of mishaps, things do not look as good. We experienced six Class B mishaps in FY05, as compared to six in FY04, so we failed to bring that number down. When we look at the Class Cs, the picture is even darker. With these, we had an increase in numbers by almost 100 percent. In FY04 we had a total of 31 Class C mishaps, compared to a total of 61 in FY05. Apart from the outstanding results regarding Class A mishaps, this is definitely a trend in the wrong direction.

Class B Mishaps

There were six Class B mishaps in FY05. Five were engine-related, but not all of those had technical causes. Each of the following mishaps is worth discussing and there are several lessons we can learn.

• The combination of high altitude and normal holding airspeed put an A-10 in the Mach/AOA regime where slat activation occurred. Moments later, the pilot felt a loss of thrust. After analyzing the situation, the pilot pulled the throttles in IDLE and went through the appropriate checklist. After the engine was shut down, the core RPM and hydraulic pressure went to zero, indicating engine seizure. The pilot returned to the base using single-engine procedures.

• The sortie was planned as a Basic Fighter Maneuver (BFM) mission. Before the first BFM engagement, the No. 1 engine compressor stalled due to a leak in the Main Fuel Control. After completing the emergency checklist procedures, the pilot flew an uneventful single-engine landing at the emergency divert airfield.

• The next Class B mishap needs a closer look. The mishap aircraft was removed for routine maintenance. A mechanic was tasked by his supervisor to remove and replace an engine part although he never received the proper training for the task. He had only been part of a team that replaced such parts while under supervision, but this time he accomplished it on his own. Unfortunately, he installed the new part on the wrong side. After a test run, the engine seized and an engine borescope revealed extensive damage.

• The mission was planned and flown as a two-ship BFM continuation training sortie. During a high aspect set-up, the left engine compressor stalled and began to overtemp. The pilot shut down the engine IAW applicable checklists, declared an emergency, and made an uneventful single-engine landing at home base.

• After approximately 15 minutes of flight and shortly after leveling at high altitude, the pilot observed the canopy seal appear to deflate. He experienced a rapid decompression followed by an abrupt rush of wind. After coordinating and performing an emergency descent, the pilot diverted to an emergency airfield and landed uneventfully.

• Approximately ten minutes after takeoff, while level at 20,000 feet, an A-10 experienced a loss of thrust on the No. 2 engine accompanied by moderate aircraft vibration.

Here are a couple of things we can take away from these Class Bs. Four of these mishaps required a single-engine recovery and all four were recovered uneventfully. We need to continue concentrating on emergency procedures training to be ready for any emergencies we may encounter. Most of the A-10 pilots who have experienced single-engine ops say it's no big deal if done correctly, but it can quickly turn into a major issue if you let your guard down and aren't prepared for it. If we go back a little in history, we see almost 10 percent of the mishaps where an A-10 was destroyed resulted from a single-engine failure. In these situations where we lost combat assets, it was because pilots let the airspeed get too low, they didn't get the speed brakes closed, or they improperly analyzed the situation which delayed them from taking the proper actions.

Out of this and out of the recent mishaps, we have to think about our preparedness for an emergency situation. Although a single-engine approach is no big deal for an F-16 pilot, an approach without two good running engines is not normal by any stretch for the A-10 community. When something out of the ordinary is going on, or the routine is interrupted, human factors become a bigger influence. Task saturation and stress could lead to a judgment error and/or mistakes in deciding on the proper and necessary course of action. Time is crucial in many cases. You have to create your own picture about the situation and make decisions based on your ability to analyze the given information. The bottom line is you need to optimize use of your emergency procedures training so if you ever encounter a demanding emergency situation, your reaction will be as natural as it is when you roll in for a strafe pass.

Class C Mishaps

If we want to make the picture of the last year complete, we also have to take into consideration the Class Cs. One big lesson learned is for the A-10 maintainers. Seven out of the 61 Class Cs were due to injuries while working on the aircraft on the ground. To reduce these injuries, know the most dangerous points around your aircraft, know the procedures, follow the tech orders, and concentrate on your work. This could protect you from becoming a statistic in the next annual summary.

All in all, it was a good year. Let's make sure FY06 is just as good. Keep your eyes open, get prepared for any kind of contingency, practice the emergency procedures as often as you can, concentrate on your task, and report all mishaps that meet the reporting criteria, even if they seem inconsequential to you. Perhaps we can identify weaknesses in the systems or procedures together before they manifest themselves into major mishaps and result in the loss of valuable combat assets. Keep in mind, unless we identify a problem, we can't take proper action to prevent situations that can turn ugly in a heartbeat.

Fly safe and have a nice year!

A-10

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	0	0.00	5	4.22	0	0.00	0	0	118,619
5 YR AVG	1.6	1.36	5.6	4.76	1.8	1.53	0.8	0.8	117,579.0
10 YR AVG	1.8	1.51	4.5	3.77	1.7	1.42	0.8	0.8	119,380.1
LIFETIME CY72-FY05	100	2.30	90	2.07	101	2.32	51	58	4,356,206

Note: This chart reflects flight-only mishaps, not all flight-related mishaps.

Airlifters

LT COL KEVIN B. TIBBS
HQ AFSC/SEFF

Strategic airlift is playing a vital role in achieving our military objectives around the world. What's driving this success story? It's been you, the aircrews and the maintainers. As much as humanly possible, you've identified the hazards and mitigated the risks to complete the mission safely. Despite our best efforts, however, the Air Force has experienced the following mishaps in FY05:

	C-17	C-5
Class As	6	1
Class Bs	12	2
Class Cs	51	37

Let's take time to review the FY05 mishaps, specifically taking an in-depth look at the Class A mishaps, so we can apply lessons learned to future operations.

Class As

Upon landing in the "desert" on a combat sortie, a C-17 experienced a main landing gear post lug assembly failure. Thankfully, no one was hurt, and the crew taxied clear to avoid closing a critical runway. Based on research and fact finding, this is approximately the 10th failure of the post lug assembly. It's what AFI91-204 would describe as "a known deficiency with a corrective action in place." A TCTO has been published with a redesign of the post lug assembly, and the estimated completion date is sometime during the spring of 2006.

Another C-17 suffered a bird strike on a low-level training mission. Striking a red-tailed hawk at almost 300 knots damaged the No. 3 engine and disintegrated the radome. The crew employed all their CRM skills to fight off pitch control problems and stick control buffeting to safely land the aircraft without further damage or injury. How can the airlift community better learn from this mishap to prevent loss of life and aircraft? The answer is education and training. Adding notes, warnings, and cautions to pubs and incorporating this mishap into annual CRM and simulator training profiles are a few of the possible corrective actions.

While flying a local training sortie, a C-17 crew observed multiple warning lights. Sometime during the flight, an improperly routed electrical wire bundle chafed and created a pinhole leak in a hydraulic line that ignited the hydraulic fluid. The heat was so intense it caused the outboard fire bottle to discharge into a fire-weakened system tubing. These tubes failed, then they damaged other internal leading edge components. The tubing violently departed the aircraft by punching a hole (12" by 18") in the underside of the wing's leading edge. This is the first known wing fire in the C-17, and the crew executed the boldface given the various WAP annunciations. Corrective actions for this mishap included a fleet-wide inspection and manufacturer quality control production improvements.

USAF Photo by Jason Minto

USAF Photo by A1C Desiree Hayden

After a go-around after touchdown, a C-17's No. 4 engine lost thrust, and the engine exhaust temperature spiked. The crew expertly performed an emergency engine shutdown and made an uneventful three-engine landing. From the start of C-17 production, the engine manufacturer has frequently tried to improve the performance and reduce the vibration of the 6th stage compressor blades. However, the investigation into this mishap revealed that one 6th stage blade liberated, causing a compressor stall and extensive internal damage to the high pressure compressor. Design fixes take time. C-17 crews and maintainers should anticipate a few more 6th stage blade failures until the corrective action is complete.

This C-17 and crew were flying a PAR approach during a desert shuttle mission at dusk in hazy conditions. Due to the final controller's repeated "below glidepath" calls, the mishap pilot (MP) arrested the descent rate by initiating a climb. During the climb, the mishap crew acquired the runway late and realized they were above glidepath. An aggressive visual descent and reduction of power caused "sink rate" and "stall" warning annunciations. The MP lowered the nose to break the stall and added power to break the sink rate. Because they were in a combat environment, the copilot recognized the excessive sink rate but allowed it to continue for a moment until calling for a go-around. In the midst of executing the go-around, the aircraft touched down with an excessive sink rate and struck the underside of the fuselage and ramp. The pilot stopped the aircraft and taxied clear. No crewmembers were injured.

What happened on the last C-17 Class A mishap? A C-17 and crew were flying another desert mission, this time to an NVG landing to a runway that was partially under repair according to the NOTAMs. The turn to final and final approach were not stable, as evidenced by numerous airspeed and altitude Central Aural Warning System alerts and course corrections near the runway surface. The crew misjudged the runway, failed to recognize the aircraft was not in a safe position to land, and failed to take the aircraft around. The aircraft landed with the right main landing gear partially off the paved runway. The right gear caught a mobile barrier that ultimately forced the aircraft off the right side of the runway.

The one and only C-5 Class A mishap occurred in the "local" pattern when the crew noticed approximately 10 to 20 gulls, then struck several while preparing to land on short final approach. Despite an attempted pull-up and go-around, birds hit the left wing flap without causing any damage, and a bird was ingested into the No. 1 engine, causing minor damage. Unfortunately, a large gull struck the No. 4 engine, breaking several fan blades and liberating fragments into the entire fan section. The crew flew an uneventful approach and landing using three-engine procedures. This base is one of many that works hard to reduce the hazard of both migratory birds and birds flocking to local ponds.

Class Bs and Cs

C-17 Class B and C mishaps can be summarized as most likely materiel failures, such as APU, thrust reverser, and ram air turbine failures. There were a few cases of failure to follow tech order data that resulted in tire and brake damage. There were a few taxi mishaps.

C-5 Class B and C mishaps similarly were characterized by APU and thrust reverser materiel failures. There was a variety of engine mishaps but no discernable trend. Bird strikes were the cause of damage in a few other mishaps.

Lessons Learned

If we wanted to save combat capability and never experience any mishaps, we'd stop flying. Of course, to ultimately win the Global War on Terror and train to grow the next generation Airmen, we'll continue to professionally maintain, fly and employ the C-17 and C-5 in harsh, demanding environments. We need to do it within a command structure that mitigates risks like "blanket waivers" and aircrew fatigue. Aircrews need to do their part by using all CRM tools available. Instructor aircrew members need to continue to demand flight discipline. An aircraft not in a safe position to land should go around; a crew should not try to salvage a poor approach…even in the combat zone.

Let's commit to increasing the margins of safety wherever and whenever possible. Congratulations on a successful year in FY05. Keep up the fight! Fly safe!

C-5

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	1	1.33	1	1.33	0	0.00	0	0	75,381
5 YR AVG	1.0	1.23	2.2	2.71	0.0	0.00	0.0	0.0	81,269.8
10 YR AVG	0.6	0.84	1.6	2.25	0.0	0.00	0.0	0.0	71,068.8
LIFETIME CY68-FY05	21	0.94	52	2.32	4	0.18	5	168	2,237,279

C-17

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	6	3.77	9	5.66	0	0.00	0	0	159,031
5 YR AVG	2.4	1.80	6.4	4.80	0.0	0.00	0.0	0.0	133,222.8
10 YR AVG	1.5	1.72	3.7	4.25	0.0	0.00	0.0	0.0	87,137.3
LIFETIME FY91-FY05	15	1.68	37	4.15	0	0.00	0	0	890,592

Note: These charts reflect flight-only mishaps, not all flight-related mishaps.

C-130

USAF Photo by MSgt Val Gempis

Table 1

Noted Trends in Class B & C Mishaps	# Class Bs	# Class Cs
Engine Confined FOD	3	12
1st Stage Turbine Failures	4	8
Falls/Jumper Injuries	2	7
Damage Caused by Bird Strike	1	9
Maintenance Operations	2	8
Reduction Gearbox Failures	2	4
Taxi Mishaps	2	4
Physiological	0	16
Brakes/Anti-Skid Failure	0	8
Lightning/Turbulence	0	6
Gear Malfunctions	0	4

MAJ CHRISTOPHER P. FROESCHNER
HQ AFSC/SEFO

This was a tragic year for the C-130 community as we suffered two Class A mishaps that destroyed two AFSOC aircraft valued at over $80 million each. One of the destroyed aircraft occurred when the MC-130 rolled out into an unmarked runway construction hole after landing at an Army-controlled airfield. The other, a controlled flight into terrain (CFIT), resulted in a destroyed aircraft and the fatalities of the entire crew on board. Air Force-wide, we lost 12 personnel (13 military personnel and one civilian) in aviation flight mishaps. Tragically, nine of the 12 fatalities were lost aboard that MC-130.

In the past year, the C-130 community experienced 22 Class B mishaps. This is the highest number of Class B mishaps on record for the Herc community and correlates to 6.5 Class B mishaps for every 100,000 hours flown, far higher than our 5- and 10-year Class B average rates of 4.51 and 3.18, respectively. Of the Class B mishaps, 14 of 22 were directly engine-related, including five first-stage turbine blade failures, three mishaps with engine-confined FOD, two reduction gearbox failures, two compressor failures/shifts, and two permanent partial injuries to parachutists who jumped from C-130s. The remaining were single occurrences that included FOD damage from airfield construction, damage to hangar doors and helicopters *inside* the hangar when a C-130 doing a standard pre-take-off engine run-up blew the hangar doors off their mounts, departure from prepared surface during taxi on icy pavement, and a dropped radar during maintenance operations.

Our Class C mishap rate was on a par with last year, with 138 reported mishaps (137 reported Class Cs in FY04). This equates to a rate near 43 per 100,000 hours flown, quite a bit higher than our 5- and 10-year Class C rate averages of 33.32 and 24.49, respectively. The numbers broke down to several common themes, primary of which was 16 physiological incidents for the year. We are hurting our people out there in many unusual ways that trend into the realm of a lack of attention to detail, rushing to get the job done, and carelessness, which I will discuss later. Rounding out the main culprits for Class C mishaps include FOD damage to engines (12), brakes and anti-skid problems (nine), bird strikes causing Class C damage (nine, including one Bald Eagle strike), 1st stage turbine failures on Dash-7 engines (eight), maintenance and ground operations actions (eight), falls and jumper injuries (four), reduction gear box failures (four), gear malfunctions (four), and lightning damage to airborne aircraft (four).

The C-130 community has continued its trend of outstanding Class E event reporting, with 1099 events in FY05, just two fewer than FY04, and that does not include the bird strike reports that caused no damage. With 514 aircraft in the Active, Guard and Reserve fleet, that is 2.14 Class Es per aircraft! Besides bird strike reports, the largest culprit was propulsion events, with 764 events recorded. Main areas reported under propulsion included in-flight shutdowns for prop and engine valve housing assemblies, oil cooler, float switch, and filter problems, and fluid level and pressure fluctuations requiring precautionary engine shutdowns. Notables that may pique the interest of the C-130 community include a reported four-engine power rollback, a dual ADI failure, a rapid depressurization, and a main landing gear that failed to retract due to ball screw failure which was hauntingly reminiscent of a mishap last year.

CFIT Class A Mishap

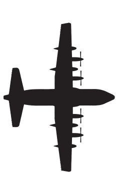
Due to the privileged nature of safety reports, all information about this mishap is taken from publicly releasable records in the Accident Investigation Board (AIB, or legal board) report. The mishap aircraft was on a training mission as part of a Joint Combined exercise. Nine crewmembers were aboard the C-130. The planned mission profile included training in night mountainous NVG and terrain following / terrain avoidance low-levels, airdrops, self-contained approaches and NVG landings. While conducting NVG operations at an altitude of approximately 1100 feet above sea level over 800-foot-high terrain, the crew did not identify and utilize what would have been the necessary start climb point to climb over a 5500-foot saddle that was the controlling terrain along that leg of their flight. The mishap navigator pointed out the terrain approximately one minute and 20 seconds prior to impact and expressed concern about their ability to climb over it. The mishap pilot initiated climb with a reduced power setting and did not utilize all available power. While still in a low power management condition, and in an attempt to fly out of the boxed canyon, the mishap pilot turned the aircraft and ultimately stalled approximately 200 feet above the mountainous terrain, destroying the aircraft and killing all nine crewmembers aboard.

According to the AIB, the accident was caused by a loss of situational awareness on the part of the entire flight deck crew that placed the mishap aircraft in a low-energy climb situation with respect to the surrounding mountainous terrain, resulting in aircraft stall. Additional factors that contributed to the mishap included the mishap crew's failure to identify, brief, and fly appropriate start climb points as required by standard NVG low-level procedures, the mishap pilots' focus on terrain masking vice terrain avoidance, the lack of timely navigation inputs, an overestimation of the mishap aircraft's climb capabilities based on experiences in less severe terrain, and low visibility due to unexpected and unpredicted clouds and very low illumination levels during NVG flight.

I think all C-130 crews can recognize the breakdowns identified by the AIB and relate them, in one way or another, to their own personal experiences. Tragically, the multiple breaks in the chain that occurred in this mishap resulted in the loss of nine fellow Airmen. It is imperative that crews plan carefully, brief thoroughly, execute conservatively and according to plan, and communicate openly while backing each other up. NVG low-level is an inherently dangerous event. It is only by careful planning and constant attention to every detail that we can ensure mission success.

Joint Class A Mishap In The AOR

Due to the privileged nature of safety reports, all information about this mishap is taken from publicly releasable records in the Accident Investigation Board (AIB, or legal board) report. The mishap aircraft (MA) was conducting a nighttime logistics transport mission in support of OPERATION IRAQI FREEDOM. The MA was landing at the second of several scheduled airfields, an airfield that had regular helicopter operations and was controlled by the Army. The NVG approach and landing were uneventful. On landing rollout, the MA encountered a large, unmarked construction crater (86 feet wide by 73 feet long by two feet 10



C-130

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	2	0.61	12	3.64	2	0.61	2	9	329,640
5 YR AVG	1.6	0.51	9.8	3.11	1.0	0.32	0.8	4.4	315,335.6
10 YR AVG	1.2	0.40	6.3	2.10	0.8	0.27	0.8	4.7	299,287.6
LIFETIME CY55-FY05	151	0.90	203	1.21	88	0.52	138	638	16,825,500

Note: This chart reflects flight-only mishaps, not all flight-related mishaps.

inches deep) on the southern end of the runway. The MA encountered the construction crater at approximately 80 knots. Following impact, the nose gear and forward undercarriage of the aircraft were sheared off, the left wing departed the aircraft outboard of the No. 2 engine, and a post-crash fire rapidly consumed the right side of the aircraft. All seven crew were able to egress safely; however, all four passengers required egress assistance from aircrew and ground personnel as they sustained injuries from serious to severe.

The AIB determined several causes for the mishap: a failure on the part of the mishap site assistant to disseminate timely NOTAM information via appropriate channels, the failure of the Army site construction project manager to ensure the construction was properly marked, and a failure of the NOTAM reporting system, to include oversight and supervision of the NOTAM processes, within the AOR. The AIB determined there were numerous opportunities for airfield construction information to flow to the aircrew, but in each case the information was not properly disseminated prior to the aircrew departing for their scheduled mission.

When I heard about this mishap, I asked myself how many times have I gone to an uncontrolled airfield and NOT done a fly-by to check out the situation. The answer came back: more than once! AOR operations require vigilance of all levels, to include self preservation, but precautions need to extend to knowledge of the environment in which we fly, take off, and land. In this case, the NOTAM system failed the crew as did several precautions that should have been taken on the field. Trust with verification is paramount in operations and a takeaway from this mishap. It could have happened to any of us, with even worse results. We need to learn from this mishap and carry those lessons with us each time we take to the skies.

Noted Class B And C Mishap Trends

Table 1 notes several mishaps that have breached the Class B and C threshold. I want to focus on a couple of areas, highlighted in the table, that need particular attention by the operators and maintainers out there. In today's high operations tempo environment, we are seeing an increase in mishaps that, if the job were done with greater care, attention, and safety in mind, could have been avoided. For example, in the area of maintenance operations, we had several preventable mishaps. A tire failed when inner bearings were not installed on the wheel. A maintainer sustained a severe cut when struck on the head by an overhead escape hatch during ground operations. Damage occurred during towing operations when a mule hit a tow bar attached to a Herc and pushed the aircraft backward into a ditch and through a fence. A fuels technician fell off a wing and broke a leg. A maintainer fell and sustained injury while replacing an emergency light. And a propeller blade was cracked during a service check when it was struck by an engine stand.

This is not a problem confined to maintenance—there are plenty of mishaps that can be attributed to the operations community as well. An aircraft struck a fire bottle during taxi operations. A crew doing a pre-departure engine run-up blew the hangar doors off a helicopter hangar, causing Class B damage. A high-speed turn of 80 degrees caused nose gear failure and tire deflation. An aircrew member broke a foot after stepping on an external power cord when exiting the aircraft. An individual suffered second-degree burns after placing a hand on a hot pitot tube. And an individual had a foot crushed when the aircraft ramp was lowered onto it. In addition, we continue to fly aircraft in the environment of severe weather that has caused six Class C mishaps due to lightning strikes and turbulence encounters. While all of these mishaps may not have been avoidable, a little extra care and safety-mindedness about how we do our jobs out there can often lead to avoiding the situation and keeping our people safe.

In addition to learning about the larger mishaps, I urge you to harness your FSO's capability to sift through the multitude of Class Es out there for good lessons learned. Today's Class E event is often tomorrow's Class A or B when we do not learn the lessons revealed from someone's hard work investigating a Class E. I will close with a recent HATR that is a testament to the problems we are encountering in our flying operations—especially in the frontier known as the AOR (28 of 38 HATRs filed involving C-130s occurred in the AOR).

As an aircrew lined up with clearance for takeoff and pushed up power with brakes set, they noticed three trucks off the right side of the runway. The crew determined the trucks not to be a factor for takeoff, but paused at the end of the runway with full power applied for 60-90 seconds to ensure the trucks' movement would keep them clear of the runway. The crew proceeded with a max effort takeoff roll. Upon reaching 95 KIAS, a dump truck pulled onto the center of the runway and stopped perpendicular to centerline. The pilot realized he would not be able to stop the aircraft in time and elected to continue the takeoff to clear the truck. The pilot used the entire runway he had available and rotated at 95 KIAS, 19 KIAS below the calculated rotate speed (corrected for Vmca) of 114 KIAS. The crew estimated they cleared the truck by no more than 40 feet.

The threat is out there all around us. Let's make sure we are not a part of that threat and mitigate the risks to an acceptably safe level. Godspeed and blue skies!

F-15

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HQ AFSC/SEFF

Florida ANG Photo photo by SSgt Shelley Gill

In his closing remarks on last year's article, my predecessor passed on kudos for the FY04 mishap statistics and urged everyone to do even better this year. I'm pleased to report that someone must have been paying attention, since the Eagle had another respectable year when looking at the Class A Flight mishap rate. There were three F-15 Class A Flight mishaps in FY05, resulting in a Class A Flight mishap rate of 1.57 per 100,000 hours. While we just squeaked ahead of last year's rate of 1.58, we did well when you compare this year's performance to the ten-year average Class A Flight mishap rate for the F-15 which is 2.09. Although we lost one valuable combat asset, we were again fortunate this year not to lose any aviators. However, we also had one Class A Aviation Ground Operations mishap in which, sadly, we lost a maintainer when he slipped off an engine ramp while performing maintenance work on a canopy. It was interesting to note that all the Class A mishaps involved F-15Cs. Of the four FY05 Class A mishaps, one was due to an aircraft departing controlled flight, one was due to a midair collision, one was due to an augmentor duct liberation, and one was due to a maintainer slipping off an engine ramp. Let's take a closer look at the Class A mishaps from last year.

• F-15C Departure from Controlled Flight. While conducting Dissimilar Basic Fighter Maneuvers (BFM), the aircraft departed controlled flight when the pilot executed an aggressive defensive jink near the maneuvering altitude floor. The aircraft entered a high oscillatory spin and the pilot was unable to recover before initiating ejection at 2200 feet above ground level.

• F-15C Midair Collision. (The following is taken from the Aircraft Investigation Board (AIB) Report.) The aircraft involved were from the same element of a flight of four. While proceeding to an air refueling area in a 2500-foot spread formation, a collision course was established when the element lead banked slightly into his wingman and neither pilot recognized the closure. The aft portion of the left wing and the forward portion of the left stabilizer of the lead aircraft impacted both vertical stabilizers on the other aircraft. Both aircraft safely recovered to home station.

This collision was the result of both the wingman's failure to maintain the briefed formation due to improper task prioritization and channelized attention, and the flight lead's failure to clear his flight path due to misperception, task misprioritization, and distraction.

• F-15C Augmentor Duct Liberation. While flying a four-ship sortie as flight lead, the pilot felt vibrations similar to going through another aircraft's jet wash. He called for a battle damage check and was informed the entire No. 1 engine augmentor section was missing. The mishap involved a known material failure, a fatigue crack on the axial stiffeners, and corrective and risk mitigation measures are in place.

• F-15C Maintenance Fatality. (The following is taken from the AIB Report.) An aircraft Structural Maintenance Technician fell backwards off the left variable intake ramp on which he and two others had been working. He struck his head on the hangar floor and lapsed into a fatal coma.

The maintenance technician and his co-workers were replacing two palm-sized panels attached to the canopy. When doing this type of work, the canopy may have to be raised and lowered several times to ensure the panels fit properly. Technical orders require that a maintenance platform be used to facilitate raising and lowering the canopy when the canopy actuator's hydraulic pressure is depleted. This was the case in this mishap, but the maintainers elected to work from the aircraft's intake ramps instead. Fatigue may have also been a factor in the mishap.

Class B Mishaps

There were 15 Class B mishaps in FY05 as compared to 11 in FY04. Of the 15 mishaps reported, just over half were engine-related. It's no surprise to anyone that it does not take a lot of visible damage to an engine to result in a hefty bill to the Air Force. The engine-related mishaps included two stalls/overtemps due to various mechanical failures, one loss of oil pressure due to an incorrectly installed seal, and five incidents of Foreign Object Damage (FOD) from various sources.

As for other Class B mishaps, an F-15C departed the runway due to loss of directional control when the right main landing gear retracted simultaneous with brake application; while another jet had its left main tire and wheel assembly depart the aircraft while on a landing roll. Another incident involved FOD damage to an engine due to tire failure on takeoff. A couple of incidents involved composite damage to a vertical stabilizer, while another airframe incident involved the structural failure of a speed brake due to composite delamination. And finally, one Class B involved a Jet Fuel Starter (JFS) malfunction which caused damage to the JFS and Central Gear Box (CGB).

Other Mishaps and Events

Of the 85 Class C and over 200 Class E events recorded, there are a couple of themes that are evident and worthy of discussion. Our feathered friends continue to try to attain air superiority with over 130 attacks recorded on the mighty Eagle. Even though the Eagle maintained air dominance, the AF still had to put up the cash to repair the results of these unprovoked attacks.

While the incidence of F-15 departures decreased slightly from the previous year, down to 36 from 38, the law of averages finally caught up with us as one of the aircraft departed at an altitude which did not allow recovery. While there is work underway to address the refurbishment of the mechanical components of the flight control system, aircrew must remain cognizant of both their operating envelopes and their aircraft configuration.

And finally, in addition to the tragic loss of life of a maintainer, there were 11 other incidents of maintainers being injured while working on the aircraft. While recognizing that working on any aircraft can be dangerous, it must be remembered that the F-15 is indeed a large aircraft. All personnel must ensure that proper ground industrial safety procedures are followed when working on AF aircraft. Maintenance personnel remain extremely valuable members of the AF community, and one unnecessary loss is one loss too many.

Lessons Learned

FY05 marked the third consecutive year that Eagle Class A rates declined. While I think the message on safely accomplishing the AF mission is being made, this year's mishaps continue to serve as reminders of hazards established in the past. Once again we've learned the hard lesson that two objects can't occupy the same point in the sky. This law applies both to our feathered friends and also to members of your flight element. The Eagle remains one of the premier air-to-air fighters. It is normally a nimble and docile aircraft in a maneuvering environment, but all aircrew need to be aware that it can still turn around to bite you if it's mishandled in the slow speed, high AOA environment.

In spite of the reminders provided courtesy of FY05's mishaps and events, it remains that the Class A rate improved, so y'all must be doing something right. Once again, give yourselves a collective "pat on the back" for last year, but strive for an even better record this year. In following the words of my predecessor, here's to keeping the "hostiles" splashing and the targets disappearing in '06.

F-15

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	4	2.09	10	5.23	1	0.52	0	0	191,331
5 YR AVG	3.6	1.89	10.6	5.56	2.0	1.05	0.6	0.6	190,618.2
10 YR AVG	4.0	2.10	9.5	4.99	2.4	1.26	0.4	0.5	190,260.8
LIFETIME CY72-FY05	127	2.45	228	4.39	108	2.08	38	45	5,189,403

Note: This chart reflects flight-only mishaps, not all flight-related mishaps.

F-16

MAJ BILL RESNIK
HQ AFSC/SEFF

USAF Photo by SMSgt David H. Lipp

The F-16 had a very good year from a safety perspective—the second best in over 25 years, topped only by FY04. There were five F-16 Class A mishaps in FY05 with a Class A Flight mishap rate of 1.46 per 100,000 hours. Compare this to the ten-year average Class A Flight mishap rate for the F-16 which is 2.76. While we lost three valuable combat assets, we were fortunate not to lose any aviators. Let's take a look at some of last year's mishaps and see what we can learn.

Class A Mishaps

Of the five FY05 Class A mishaps, two were due to tire failures, two were engine-related, and one was a stuck throttle with an unsuccessful flameout landing.

F-16C Tire Tread Separation. Just prior to becoming airborne, the pilot heard a loud noise accompanied by severe vibrations. The pilot checked the engines and continued the takeoff. Once airborne, the pilot was informed that the right main tire was damaged. After burning down fuel, the plan was to engage the approach end barrier. Just after touchdown and prior to cable engagement, the right main gear began to collapse. The aircraft settled on the right triple ejector rack (TER) and sustained additional damage to the right side of the fuselage, right strake, right ventral fin, right horizontal stab, and hook assembly. The pilot egressed without injury.

The tire tread separation led to vibrations which in turn damaged the right main landing gear assembly, allowing it to collapse on landing.

F-16C Tire Failure. At an unknown time, a foreign object damaged the inner lining of the left main landing gear tire, which resulted in the tire failing at high speed on takeoff. The pilot elected to abort, but was unable to engage the departure end cable on the runway. The aircraft departed the end of the runway and engaged the cable in the overrun. The aircraft sustained damage to the brake and wheel assembly and to the engine when firefighters extinguished a fire that broke out due to leaking hydraulic fluid. The pilot egressed without injury.

F-16D Engine Failure. (Taken from the Accident Investigation Board (AIB) Report.) An F-16D, flying a Basic Fighter Maneuvers (BFM) mission, experienced a catastrophic engine failure while en route to the training area. The engine failure was the result of a High Pressure Turbine (HPT) blade failure caused by the required blade seals not being installed in the HPT rotor assembly during scheduled maintenance. The aircraft was unable to make it to an emergency divert field and the pilot and passenger ejected safely.

F-16C Engine Fire. During a BFM engagement, the aircraft experienced an engine fire due to a fuel leak. The pilot turned toward an emergency divert field and began a climb to set-up for a flameout landing. Meanwhile, the fire burned through wiring in the aft part of the aircraft, partially degrading aircraft flight controls, wheel brakes, speedbrakes, and nozzle actuators (the nozzle became stuck closed). The pilot set up for a straight-in flameout landing, but due to the degraded systems was unable to stop the aircraft on the runway. Prior to runway departure, the pilot ejected and sustained only minor injuries.

F-16D Stuck Throttle. (Taken from the AIB Report.) An F-16D flying a cross-country deployment mission experienced a stuck throttle on takeoff. The pilot was unable to retard the throttle out of afterburner (AB) and, after consultations with the Supervisor of Flying and Lockheed Martin, selected SEC to terminate the AB. The pilot elected to set up for a straight-in flameout landing and planned to shut the engine down with the Main Fuel Shutoff Valve. While maneuvering for the approach, the engine stalled/stagnated. The pilot ejected when it was clear the aircraft would not reach the runway.

The stuck throttle resulted from a briefcase in the rear cockpit shifting on takeoff and becoming wedged between the seat and the throttle. The failure to make the runway resulted from the pilot not maintaining a position from which a flameout landing could be made in the event of an engine failure.

Class B Mishaps

There were eight Class B mishaps in FY05 as compared to 14 in FY04. Three were engine-related, two were bird strikes, one was a gear collapse on landing, one was an impact with approach lights on landing, and one was an injury to a maintainer.

Two of the three engine-related mishaps were due to external foreign objects. The third was a result of a fan blade liberation in flight.

Of the two bird strike mishaps, one occurred on takeoff roll and the other occurred on the range. The bird strike that occurred in flight resulted in damage to the fuselage, and the pilot returned to home station uneventfully.

Of the two class B mishaps that occurred on landing, one was a gear collapse that resulted from strut failure and the other was the result of landing short of the runway while accomplishing an Instrument Landing System approach in the rain. The pilot went below the glidepath after breaking out of the weather, impacted the approach lights, and touched down in the overrun.

The injury to the maintainer occurred during maintenance on the flight controls when his hand was resting on the aft fuselage near the horizontal stabilizer. His thumb was severed when the stab was actuated.

Class C Mishaps

There were 74 Class C mishaps last fiscal year (the same number as FY04, but higher than the few previous years). The biggest trend noted is injuries to personnel working in/around aircraft (14 total). The injuries varied and included such things as lacerations and muscle strains. Engine issues were the second most prevalent and resulted in eight Class C mishaps.

Lessons Learned

One of the big lessons we can take away from the FY05 mishaps is the need to brush up on the basics. In two of the Class A mishaps, failure to follow procedures resulted in the loss of two valuable combat aircraft. Knowing basic rules and knowing basic emergency procedures should be second nature. While the F-16 flies a variety of missions, and the associated information required to maintain proficiency in all those missions can be overwhelming, we can't let the basics go by the wayside.

Additionally, everyone needs to understand that engine fires with normal engine indications can still do major damage to aircraft systems. We all must realize an apparently normally operating engine isn't the only concern we should have. We need to be aware of the potential impact on other systems and plan accordingly.

A couple of high-speed tire failures on takeoff highlight the need to have a game plan in mind every time we take off or land. Prior to taking the runway for takeoff, we should do one last review of our "what if" game plan—go/no-go decisions, ejection situations, etc. On landing, think about what you'll do if you have a tire or brake failure.

Lastly, everyone needs to make sure they're paying attention when working in/around aircraft and using proper procedures. If we lose focus or try to cut corners to get the job done faster, the consequences can be catastrophic. In the F-16, we were lucky the injuries we experienced last year didn't result in any fatalities, unfortunately though, in another weapons system, a maintainer was killed while working on an aircraft when the team he was working with failed to use the right equipment.

Overall, FY05 was a great year for the Viper, but we should always strive to do better. As the war on terrorism continues, we need to do all we can to preserve our combat capability. Keep in the books, stay ahead of the jet, and fly safe!

F-16

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	5	1.46	4	1.16	3	0.87	0	0	343,533
5 YR AVG	7.6	2.17	5.0	1.43	6.6	1.89	1.8	2.2	349,662.0
10 YR AVG	9.8	2.76	4.0	1.13	8.8	2.48	1.8	2.3	354,547.0
LIFETIME CY75-FY05	312	3.87	66	0.82	292	3.62	77	115	8,062,244

Note: This chart reflects flight-only mishaps, not all flight-related mishaps.

KC-10


USAF Photo by MSgt Lance Cheung

MAJ BOB ROUKEMA
HQ AFSC/SEFF

The KC-10 had another good year with only one Class A and three Class Bs. We continue to maintain an MDS lifetime record of no lost aircraft or fatalities. Class C events are down significantly this year; six from 16 last year. And finally, Class E reports (excluding BASH) remained essentially the same.

With so few mishaps to discuss, it will be easy to group these by types of events.

Engine-Related

Class A. At an unknown time, the No. 3 engine stage 1 high pressure turbine (HPT) nozzle midcone developed a fracture. During a planned go-around, the fractured area buckled, resulting in a rapid decrease in N1 speed followed by the seizure of the engine. The crew accomplished the appropriate checklists and performed an uneventful engine-out approach and landing.

Class B FOD. At an unknown time, the mishap engine ingested a cadmium-plated, 300-series stainless steel fastener, which caused damage to all 14 stages of the high-pressure compressor (HPC). This same engine also ingested a bird sometime after the fastener. The damage was discovered when a crew reported an engine overspeed. Because of the overspeed, maintenance performed a borescope analysis which discovered the FOD damage and the bird strike.

Class C. Shortly after V1 decision speed, the No. 3 engine fire light illuminated and the fire bell sounded. At about 500 feet, the crew initiated the Engine Failure/Fire/Severe Damage checklist and climbed to 3000 feet to assess damage and reconfigure for landing. Recovery to landing was uneventful. Analysis showed the 14th air stage duct separated from the high-pressure bleed valve. The nut that holds the 14th stage clamp onto the 14th stage duct was missing. The bolt and nut on the opposite side of the clamp were sitting flush, indicating improper installation.

BASH

Despite over 200 BASH reports, only a few caused significant damage.

On climbout following a touch-and-go, the aircraft struck two or three birds. The crew heard the loud bang and suspected a bird strike, although no birds had been seen. The aircrew elected to execute a precautionary landing. Upon inspection, the scanner discovered Class C impact damage to the slat system on the right wing.

A KC-10 struck a large white bird on the radome during takeoff roll at approximately 145 knots and aborted on the runway. The crew taxied clear of the runway, called for a stair truck, and ran the abnormal brake checklist. They noticed the brakes were overheating and would soon be in the danger zone. Since no stair truck was available, the crew safely executed an emergency ground egress on the taxiway. There were no injuries to the crewmembers or passengers.

On departure at rotation speed (approximately 155 knots) the crew noticed birds transiting under the nose of the aircraft from left to right, but no impacts were heard or felt. After becoming airborne, the crew noticed a slight vibration and isolated the vibration to the No. 1 engine. The crew elected to leave the throttle at idle and made an uneventful recovery to the departure base. Post-flight inspection revealed a number of bird-damaged fan blades, as well as some acoustic panel damage.

Maintenance And Logistics

A maintainer was sent to the hospital with a dislocated shoulder when a cable broke on the sling they were using to lower a Wing Air Refueling Pod (WARP) onto the cradle/dolly. The pod rolled out of the sling and fell inverted into the cradle/dolly. In addition to the injury, the pod and dolly were damaged.

While completing engine repairs from a bird strike, the maintenance repair team received and installed N1 fan blades that had been marked with inaccurate weights. The incorrect weights were consequently entered into the fan balancing software that determines the optimum fan blade arrangement. The erroneous inputs led to a bad output, and the blades were installed in an unbalanced arrangement that caused engine vibrations, resulting in Class B engine damage.

Air Refueling

The second contact to the left WARP resulted in a failure indication shortly after contact. All attempts to extend the left hose to full trail or rewind the hose were unsuccessful. All further troubleshooting of the left WARP was unsuccessful, and the hose remained in the 10 feet short of full trail position. The crew safely landed the aircraft with the WARP basket and hose impacting the ground approximately 1000 feet down the runway, resulting in Class C damage.

The third F-18 in a flight made contact with the drogue and a hose sine wave ensued. The F-18 was told to disconnect. During the disconnect, the probe was ripped off, remaining in the basket.

Class E Events

Under the category of "could have been worse" are the Class E events. NMAC and TCAS RA were about the same as last year. Of the 17 NMAC and TCAS RAs, six were in Iraq near Baghdad and Balad and eight (including the one highlighted below) were in the northeast United States near McGuire and Dover. You can draw your own conclusions about which part of the world offers the most dangerous flying environment. Here's a sample:

A KC-10 mistakenly thought a climb clearance was for them. In his read-back to ATC, the pilot omitted his call-sign and only responded with "cleared to ....." ATC thought the right aircraft had responded. The result was both aircraft were not following ATC directions.

There were only four reports of Smoke and Fumes. One was believed to be residual fuel from previous maintenance, another was found to be a loose fitting in the Air Refueling Operator's (ARO) compartment, and another indicated fuel leaking below the valve actuator but could not be duplicated on the ground. Finally, the last report stated the source could not be determined.

One other fuel-related event involved a small hole in the drogue hose. The aircraft commander and flight engineer confirmed that fuel was streaming from the drogue reel assembly area after performing a 55 Knot Speed Reduction Test on the centerline drogue. They shut down all power with the Air Refueling Master Power Switch, scavenged fuel from the tanker manifold, and verified the boom/drogue valves were closed.

Conclusions

Flying hours for FY05 were about the same as the five-year average, and the numbers of mishaps, especially Class Cs, were down. Does that mean we're flying safer? I hope so, but I don't think the change is statistically significant enough to draw that conclusion. Of course, some of these events are a result of bird strikes and material failure that are hard to prevent. But there are few mishaps we cannot prepare for. The reports this year are filled with indications of proper preparation and decisive crew action. Kudos to these crews and all the other KC-10 operators and maintainers that continue to do such great work and keep the statistics looking so good year after year for the KC-10. Keep up the great work and fly safe!

KC-10

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	1	1.65	3	4.94	0	0.00	0	0	60,739
5 YR AVG	1.2	1.93	2.4	3.85	0.0	0.00	0.0	0.0	62,313.6
10 YR AVG	0.9	1.59	1.3	2.30	0.0	0.00	0.0	0.0	56,431.0
LIFETIME CY81-FY05	11	1.00	18	1.64	0	0.00	0.0	0.0	1,097,131

Note: This chart reflects flight-only mishaps, not all flight-related mishaps.

KC-135

MAJ BOB ROUKEMA
HQ AFSC/SEFF

USAF Photo by SSgt Valerie Smith

The KC-135 five- and 10-year mishap rates have never been lower. And, knock on wood, that trend will continue for a long time to come. However, we still continue to see events that indicate a lot of potential for more serious mishaps. Clear air turbulence was involved in the mishap sequence of events for the only Class A this past year. There was an air refueling-related Class B that sounds like it could have been much worse. We also continue to have a high number of near-midair collision reports and runway incursions that should make you wonder if we're being as safe as we can be.

Some Comments About The Numbers

We've had a lot of discussion about various categories of mishaps. Sometimes that impacts the year-end statistics we have to discuss for the different aircraft. The most recent example of these evolving reporting requirements is the AFI 91-204, Aircraft Ground Operations (AGO), category. In FY05 we've had 21 Class C events where a maintainer was injured while working on the aircraft; the year before we had one Class C report filed in the same way. While this seems like a significant increase in the reported incidents, it is not. This past year, many incidents that would have been reported as ground or industrial events were reported as flight-related. To verify that, I checked with the Ground Safety guys. In FY04 we had 13 ground reports of the maintainers sustaining injuries while working on the aircraft and only one reported as flight-related. In FY05, we had 21 occurrences of a flight-related injury, all of which would have been reported differently in previous years. That's going to get fixed.

An interim change (IMC) to AFI 91-204, *Safety Investigations and Reports*, has been released. It redefines AGO as: *"A mishap involving DoD aircraft, with an aircrew member on board, that occurs between engine* *start/shutdown and prior to/following intent for flight that results in reportable property damage or any injury or fatality. Damage to a missile prior to the completion of weapons upload procedures, or after initiation of weapons download procedures is a Missile mishap."* This should reestablish some consistency in reporting.

Last year Major Harveaux wrote about an increase in lightning strikes. This year, the number of events is back down to FY03 rates. We also had a good drop in the number of air refueling-related Class C events, particularly Multi-Point Refueling System (MPRS)-related events; down to 12 overall Class C events from last year's 24. MPRS Class C events were down to four from a high of nine.

As far as the HAPs and HATRs, the overall numbers appear to be about the same from last year, with only minor differences in the reporting categories. For example, an FY04 report filed in the Air Traffic Control category may have been filed as a Near-Midair collision in FY05.

With all that in mind, I pulled out a few summaries from the categories we seem to see the most of.

Weather-Related

Since clear air turbulence was involved in our only Class A mishap, I'll cover it first.

The KC-135R was cruising at FL370 east of the southern Bahamas with 41 passengers. Factors considered necessary for clear-air turbulence were not forecasted and not expected. When the aircraft encountered the turbulence, it abruptly dropped 380 feet in six seconds, resulting in a -1.24G environment. The aircraft then quickly entered a +1.5G recovery. Several passenger injuries were incurred during the incident, and this mishap is categorized as a Class A mishap due to the nature of these injuries.

One other turbulence incident resulted in the minor injury of a passemger. In this Class C event, the aircraft was in IMC conditions at FL350, but no thunderstorms had been detected on the radar.

Four lightning strikes also occurred in FY05. This is down from a high of eight last year. Does everyone remember the five favorable conditions for a lightning strike from last year's KC-135 article?

(Editor's Note: To save you the trouble of looking for your dog-eared copy of last year's EOY Mishap Review, we'll quote it: "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:

(1) being within 8° C of the freezing level;

(2) being within 5000 feet of the freezing level;

(3) being in light precipitation;

(4) being in clouds; or,

(5) being 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).")

Air Refueling-Related

The most severe refueling-related incident was a Class B, but could have been much worse.

Excessive closure was nearly catastrophic in a Class B refueling incident. The incident began with an unstable approach by the receiver in hazy conditions. It ended with the tanker missing the Boom Assembly and right hydraulics. The board identified several factors your safety office can brief you on, but both crews used up a lot of their luck that day.

There were nine reported incidents of ice shield damage. Two of these were attributed to landing with the boom in trail. Seven were from contacting the receiver aircraft. There were also two Class C events resulting from brute force disconnects. Many of these events sound remarkably similar and preventable. Here are a few:

- The boom ice shield was damaged during a night air refueling at 11,000 MSL, in visual meteorological conditions with light turbulence and haze. The receiver's first attempt at contact was unsuccessful after he did not stabilize in the contact position. In his second attempt, he was too high in elevation and did not arrest his forward movement.
- During the first refueling of a fighter, it was noted that he had a tendency to "come in pretty fast." On the second set, he once again closed faster than normal. The boom operator made a normal contact with him in the middle of the refueling envelope, but the receiver continued to move toward the inner limit. The boom operator started to call "back four," but decided to call a breakaway instead. Before he could key the microphone to call "Breakaway," the receiver stopped its forward motion and started backing out, and a disconnect occurred.
- The 135 receiver was six to seven feet away from the boom, stable and centered at 28 to 30 degrees elevation. The boom operator called for him to move back three, but the receiver continued to hold position at about six feet. When he started to move forward, the boom operator initiated a disconnect and manually retracted the boom. The receiver continued to move forward to about three feet away, until moving back and away from the boom.

MPRS failures were down to four this year. In one case the hose was intentionally jettisoned because it could not be retracted. In another, the hose assembly fell off. In an incident with a Tornado, the receiver's probe was broken off and the tanker's main chain link broken on the (Primary) Tensator Drive Chain Assembly. Finally, the 2A maintenance inspection performed after flight, revealed both air-driven generator impellers had one blade missing, which caused oscillations during AR.

Landings

There were eight incidents of scraping pods on landing, two in the RC-135. Some of these are summarized below.

• The most eye-opening landing incident involved an RC-135. During traffic pattern, the RC-135 made an immediate left-turn to avoid a potential traffic conflict with another 135 flying an opposite direction approach. The turn caused the RC-135 to scrape its No. 1 engine pod on the runway surface. This is an ongoing investigation, so the board's conclusions are not yet available.

• Crosswind controls during a gust on landing led to the scraping of both left-side engines nacelles of a KC-135R. Class B damage included a sizeable hole in the No. 2 generator, accessory and transfer gearbox damage, and damage to six engine cowlings.

• Another crosswind incident resulted in Class B damage to the right-side engine nacelles. In this case, proper crosswind controls were not maintained during a bounce recovery.

• One hard landing occurred out of a visual approach. The aircraft crossed the threshold high and four knots fast. The flare was late, and a go-around was initiated on the bounce. Although the hard landing indicator did not illuminate, the crew elected to report the hard landing based on their perceptions; a good call, based on the damage.

• In another incident, the pilot landed right of centerline with right crab. When the aircraft lurched right at touchdown, the pilot released right aileron input and the left wing dipped to the runway, scraping the No. 2 nacelle.

• In a KC-135E, the pilot was braking from the right seat after settling to the runway after a slight landing bounce. Without anti-skid protection the No. 4 and 8 tires blew.

• In another Class C event, seven of eight tires blew as a result of a mechanical interference between turnbuckle safety cabling on one of the mishap aircraft's (MA) brake control cables and a parking brake pawl. The interference resulted in an open parking brake circuit, which caused the MA's anti-skid braking system to disengage during landing.

Maintenance Mishaps

While preparing to replace the MLG door actuator of an alert configured aircraft, the maintainers did not recognize the nose gear did not have its downlock pins installed. When they repositioned the gear handle, the nose gear retracted and the aircraft nose and No. 2 and 3 engine nacelles impacted the ground, resulting in Class B damage.

The other Class B incident occurred when the No. 1 engine suffered FOD damage during a maintenance engine run. It ingested ice from a nearby puddle.

HAPs And HATRs

NMAC and TCAS RA reports were up from last year at 24 and, as I mentioned earlier, part of this could be differences in reporting. By adding NMAC, TCAS RA, Pilot Procedure Reports, Air Traffic Control, and Runway Incursions events, the numbers have stayed pretty consistent from last year. Statistically, with 40 per cent of these events occurring in theater, OIF and OEF operations don't seem that much different. But reading these reports will probably tell you what you already know—operations from deployed locations have a high potential for mishaps.

There were four incidents of unauthorized access to the runway.

• One was a tanker taxiing across an active runway at an international airport without clearance.

• One was a vehicle that caused concern but posed no real danger.

• A Cessna 172 tried to share the runway with a tanker cleared for the approach and option. In that incident the crew saw the smaller aircraft just in time to execute a go-around and passed an estimated 50 feet above the Cessna.

• Finally, another aircraft taxied across an active runway without clearance while a tanker was on final.

Conclusions

Once again, the 135 community has been doing well keeping the mishap rates low. But some of those mishap reports we saw indicate potential for more serious accidents. I'm not so superstitious that I say, "It's only a matter of time," because I believe the Air Force is filled with professional aviators with superior training. I will say the chances of a serious mishap go up considerably when we discount our professional standards and fail to maintain our training standards.

Make sure you stay in the books, plan and preflight thoroughly, and fly with anticipation. Finally, if you see a hazard, report it. It is more palatable to act on a recommendation from a HATR than to have to act on a recommendation from a mishap.

Keep up the good work, and fly safe.

KC-135

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	0	0.00	13	5.07	0	0.00	0	0	256,531
5 YR AVG	0.4	0.17	7.2	3.07	0.0	0.00	0.0	0.0	234,760.8
10 YR AVG	0.4	0.18	4.0	1.82	0.1	0.05	0.2	0.4	219,734.2
LIFETIME CY57-FY05	81	0.62	156	1.19	64	0.49	134	629	13,107,131

Note: This chart reflects flight-only mishaps, not all flight-related mishaps.

USAF Photo

Surveillance/Recce

MAJ JEFF RITCHIE
HQ AFSC/SEAI

E-3

The E-3 AWACS (Airborne Warning and Control System) community had zero Class A, five Class B and three Class C mishaps in FY05. Additionally, the AWACS experienced 89 Class E events.

Class B

• A carbon seal failure caused an engine to seize during climb out. The aircrew returned to home station, adjusted gross weight and recovered the aircraft with the remaining three engines.

• An engine seized shortly after level-off because an engine gear box drive angle nut severed the tower shaft. The aircrew returned to home station, burned down fuel and performed a three-engine landing.

• Multiple radar failures during flight caused the aircrew to end a mission early. While troubleshooting the radar problems on the ground, maintenance discovered damage to the rotary joint. The damage was the result of a seized bearing.

• During the post-flight inspection, maintenance discovered damage to the first-stage compressor blades and a missing rivet on the No. 4 engine. A borescope revealed further damage to several internal compressor blades on various stages. The investigation is ongoing.

• Maintenance discovered damage to the No. 2 engine's first stage fan blades during the post-flight inspection. A borescope revealed further damage throughout the engine. The investigation is ongoing.

Class C

• An aircraft's left forward trailing edge flaps were damaged when maintenance personnel lowered them onto a tool box.

• An individual sustained multiple injuries while falling through the forward lower lobe hatch during a pre-exercise safety inspection.

• Damage resulted from a loss of fluid in the aircraft's utility hydraulic system while the aircrew was performing radar patterns. The aircrew safely recovered the aircraft. The investigation is ongoing.

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 19 smoke and/or fumes events, five were caused by aft forced air fans, three were attributed to faulty transformer rectifier units, two were caused by plastic utensils left in or around hot surfaces at the galley, one was a primary power feeder duct fan failure, one resulted from an overheated wiring bundle, one was attributed to an IFF R/T, and one was caused by a failed air cycle machine. In five 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 47 bird strikes, eight engine shutdowns (six oil system component malfunctions, EGT thermo coupler wiring problem, faulty fire warning system), three Hazardous Air Traffic Reports (HATRs), three physiological events, two dented/scratched aircraft from improper ground handling, two flight control problems, an engine flameout due to a faulty engine fuel pump, APU exhaust entering the cabin, an inadvertent stall, a boom strike on the pilot's window, utility hydraulic loss, and a spoiler position transmitter failure.

USAF Photos

E-4

The E-4 National Airborne Operations Center (NAOC) community had one Class A mishap, one Class B mishap and one Class C mishap this year. There were 28 Class E events for the E-4 this year.

Class A

During transition training the No. 2 engine ingested a Canada goose and suffered catastrophic failure. The aircrew applied critical action procedures and recovered the aircraft with three engines.

Class B

While executing a practice approach, the aircrew heard several loud "bangs" that they determined to be compressor stalls in the No. 3 engine. They applied critical action procedures and executed a three-engine full stop. Depot analysis determined a high pressure compressor S-9 vane failed, liberated and caused a chain reaction of damage throughout the engine.

Class C

A left over-wing fairing mounted escape slide departed an aircraft during an approach. It impacted the left-wing flap and aft lower fuselage causing minor damage. The aircrew landed the aircraft uneventfully.

Class E

There were 23 bird strikes, three engine shutdowns (failed V-band clamp, bad oil pressure transmitter and faulty oil temperature sensor wire), one HATR and an incident where a high maintenance stand struck an aircraft's nose radome.

E-8

The E-8 Joint Surveillance and Target Attack Radar System (JSTARS) operated another year without a Class A. The community's mishaps and events include two Class Bs , four Class Cs and 68 Class Es.

Class B

- Maintenance discovered damage to an engine during the post-flight inspection. The investigation is ongoing.
- The crew chief noticed flames coming from the No. 4 engine exhaust during start and directed the aircrew to shut down the engine. A boroscope inspection revealed damage throughout the engine. The investigation is ongoing.

Class C

- The No. 3 oil low-pressure light illuminated, followed by rapidly decreasing oil pressure. The aircrew shut down the engine, returned to home base and performed a three-engine full stop. Depot analysis of the engine revealed the accessory and component drive bevel gear shaft lower bearing failed.
- A string of circumstances led to a landing in the brake energy caution zone and longer than normal taxi distance. Hot brakes were the result and maintenance replaced tires, brakes and an escape slide.

- Eight hours into the sortie the No. 3 oil low-pressure light illuminated. The aircrew reduced power on the engine and the light went out. Fifteen minutes later the light came back on. The aircrew shut down the engine, returned to base and landed uneventfully with the remaining three engines. Teardown analysis revealed the No. 4 and 5 scavenge pump bearings failed.

• The aircrew shut down the No. 4 engine approximately three-and-a-half hours into the sortie after the oil low-pressure light illuminated, the oil pressure dropped to zero and the oil temperature began to rise. The aircraft was landed at a divert base with the remaining three engines. The engine is awaiting teardown analysis and the investigation is ongoing.

Class E

There were twice as many engine shut downs this year as compared to last year (14 total). Eight of the events were oil system-related, three were false fire lights, one was due to engine vibration (fuel pump), one was due to erroneous engine readings due to faulty wiring and one was the result of faulty GCU causing a generator overheat light.

Other Class E events included 44 bird strikes, five smoke/fumes incidents, two physiological incidents and two HATRs.

runway requiring cosmetic fixes to the pod and replacement of the Jet Fuel Starter.

• An individual was injured (separated shoulder and sprained thumb) and a computer processor was destroyed during an unsuccessful attempt to load it on the aircraft through the crew entry chute.

• The No. 8 fore flap separated from the aircraft while the aircrew conducted transition training. The aircrew landed safely. Additional damage was found on the cove lip door.

• Another aircrew contacted the runway with the No. 3 engine pod during a touch-and-go. The aircrew landed safely and discovered damage to the pod and the Jet Fuel Starter.

• The Engine Failure Assist System Failure Light came on during takeoff roll. The aircrew initiated an abort at 133 knots and applied brakes at 130 knots (hot brakes speed was 93 knots). The aircrew parked the aircraft in the hot brakes area and egressed the aircraft. Damage occurred to the brakes and tires.

• One more aircrew scraped the No. 3 engine pod during a touch-and-go. The aircrew landed safely and

USAF Photo by TSgt Robert J. Horstman

RC-135

The RC-135 community experienced one Class B and two Class C mishaps this year. They also had 78 Class E events.

Class B

The aircrew used 20 degrees of bank immediately after a touch-and-go to avoid opposite direction landing traffic. The No. 1 engine contacted the runway, damaging the cowling and gearbox. The aircrew avoided the opposite direction traffic and safely landed the aircraft.

Class C

• The aircrew used excessive bank for conditions while in a three-point attitude during a full-stop landing. The No. 3 engine pod contacted the

discovered damage to the pod and the Jet Fuel Starter.

• Shortly after takeoff, the No. 4 throttle control rod disconnected from the fuel control causing the engine to remain in the last setting commanded by the aircrew (takeoff power). The aircrew successfully shutdown the engine by bringing the throttle to the cut-off position after noticing a rising Exhaust Gas Temperature. The engine sustained heat damage prior to its shutdown.

Class E

There were 57 bird strikes, 6 in-flight engine shutdowns, 4 engine flameouts during ground ops, 3 smoke/fumes incidents, 2 physiological incidents, 2 HATRs, an autopilot malfunction, a lightning strike, a ground incident that damaged the flaps and a thrust reverser that deployed during flight.


USAF Photo by TSgt Erik Gudmundson

U-2

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

Class A

Shortly after beginning a night instrument approach at the end of a sortie, the aircraft impacted terrain without an ejection attempt by the pilot. The pilot was fatally injured and the aircraft was destroyed.

Class B

A chain of events led to a catastrophic AC relay failure, explosion and fire while maintenance personnel were troubleshooting primary mission equipment write-ups from the previous sortie.

Class C

• Maintenance personnel unloaded an aircraft from the ground handling cart with the main landing gear doors still connected and caused extensive damage.

• Debris on the free-running nut lower track caused damage and the flaps to stop at approximately 18 degrees while a pilot configured for landing.

• Three data cards within the primary mission equipment two system were overheated and damaged during ground operations.

• Maintenance personnel damaged the aircraft's right spoiler while performing fill and bleed procedures on the lift spoiler system.

• The pilot exited the runway and struck a runway edge light while landing in excessive gusty crosswind conditions.

• A maintenance member slipped, fell and fractured a tibia while attempting to climb on the wing for a squadron photo.

• While preparing an aircraft for towing, a maintenance member was struck on the back by the right wing and spent four days in the hospital.

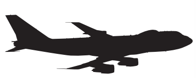
• A maintenance member accidentally dropped a coupler onto the elevator. The elevator had to be replaced.

Class E

There were nine Class E events for the year. Three were uncommanded pitch incidents, two were bird strikes, one was an uncommanded flap movement, one occurred because of chaffing in a wire bundle, one was an autopilot malfunction and one happened when an aircraft struck ground equipment while being towed.

E-3

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	0	0.00	4	21.19	0	0.0	0	0	18,876
5 YR AVG	0.0	0.00	1.4	6.38	0.0	0.00	0.0	0.0	21,952.6
10 YR AVG	0.0	0.00	0.8	3.69	0.0	0.00	0.0	2.0	21,698.7
LIFETIME CY77-FY05	1	0.15	10	1.51	1	0.15	2	24	663,483



E-4

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	1	62.46	1	62.46	0	0.00	0	0	1,601
5 YR AVG	0.6	37.34	1.0	62.89	0.0	0.00	0.0	0.0	1,590.0
10 YR AVG	0.3	20.51	0.6	41.02	0.0	0.00	0.0	0.0	1,462.8
LIFETIME CY75-FY05	5	9.85	8	15.76	0	0.00	0	0	50,776

E-8

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	0	0.00	1	9.85	0	0.00	0	0	10,150
5 YR AVG	0.0	0.00	0.2	2.40	0.0	0.00	0.0	0.0	8,340.0
10 YR AVG	0.1	1.88	0.2	3.75	0.0	0.00	0.0	0.0	5,333.1
LIFETIME FY91-FY05	1	1.78	2	3.57	0	0.00	0	0	56,058

RC-135

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	0	0.00	13	5.07	0	0.00	0	0	256,531
5 YR AVG	0.4	0.17	7.2	3.07	0.0	0.00	0.0	0.0	234,760.8
10 YR AVG	0.4	0.18	4.0	1.82	0.1	0.05	0.2	0.4	219,734.2
LIFETIME CY57-FY05	81	0.62	156	1.19	64	0.49	134	629	13,107,131

U-2

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	1	7.51	0	0.00	1	7.51	1	1	13,323
5 YR AVG	0.6	4.63	0.0	0.00	0.4	3.09	0.2	0.2	12,961.6
10 YR AVG	0.8	6.29	0.0	0.00	0.3	2.36	0.2	0.3	12,722.9
LIFETIME CY63-FY05	30	6.63	1	0.22	22	4.86	8	13	452,707

Note: These charts reflect flight-only mishaps, not all flight-related mishaps.

BASH

FY05 Strike Stats

LT COL TED WILKENS
CAPT MELANIE PRESUTO
HQ AFSC/SEFW

Another fiscal year has come to a close. Strike reporting hit a record high in FY05 with 5128 strikes recorded. Statistical data from Safety Automated System reports indicated that 98 percent (5047) of the bird strikes were Class E events. We experienced three Class A mishaps, which accounted for $10,776,464 (51 percent) of our total FY05 cost of $21,244,681. Fortunately, no aircrew or aircraft were lost to wildlife strikes this past year. There were 10 Class B and 68 Class C wildlife mishaps, resulting in $9,523,718 (45 percent) of the total cost.

As expected, about 45 percent of our strikes occurred in the airfield environment, while eight percent occurred during low-level and range operations. These statistics are slightly lower than last year, but the "unknown" category increased this year. What is strikingly different this year over past years is that airfield-related strikes accounted for 71 percent of the annual damage cost. Two Class A wildlife mishaps in the pattern explain why the cost percentage is high. Typically, most damage occurs in low-level and range operations when an aircraft is flying fast in wildlife-saturated airspace. The third Class A mishap occurred when a C-17 struck a Red-Tailed Hawk during low-level operations.

The top ten species struck, as noted in the accompanying tables, include many familiar names from years past. We continue to strike many perching birds, small passerines not categorized by the Smithsonian Institution, mainly in the airfield environment. Striking these small song birds usually results in minor damage when compared to strike totals. Two exceptions this year are the Killdeer and Eastern/Western Meadowlarks. Killdeer accounted for only 98 strikes, but totaled $311,225 in damage. Meadowlarks accounted for only 80 strikes, but totaled $389,421 in damage. It was no surprise that geese cause large amounts of damage with low reported strike events.

Two of the three Class A mishaps involved engine ingestions of Laughing Gulls and Canada Geese on a C-5 and E-4, respectively, while pattern operations were conducted during the dusk period (+/-1 hour of sunset). Both aircraft struck multiple birds. These two incidents accounted for $9,739,896 (45 percent) of the total annual cost. Detailed mission scheduling and planning, proper risk management assessment, and extreme vigilance during operations must be exercised when executing flight operations during dawn and dusk periods, regardless of the Phase designation. AFPAM91-212, paragraph 2.5.2, strongly recommends, "Flying one hour before and after dawn and dusk should be avoided unless absolutely nec-

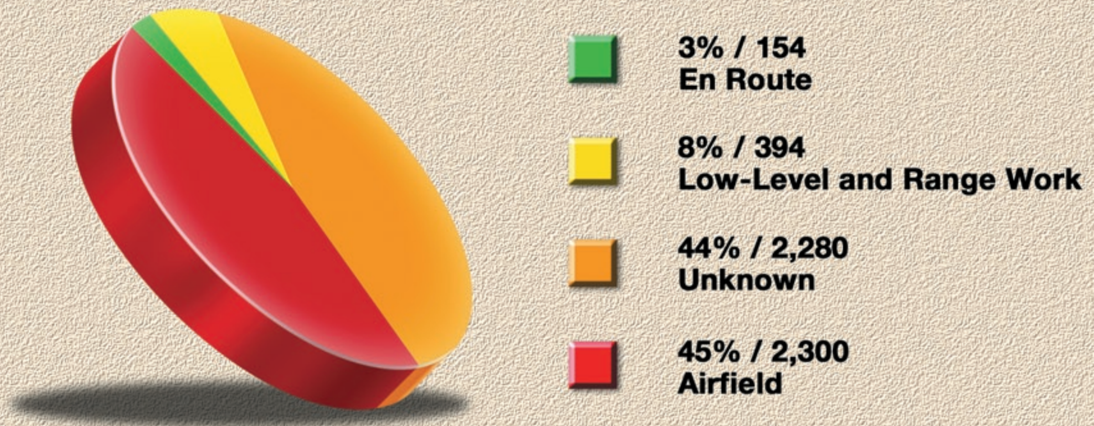
FY05 Top 10 Wildlife Strikes by Count

Common Name	# Strikes	Cost
Perching Birds	427	$182,439
Swallows	165	$26,196
Horned Lark	156	$22,710
American Mourning Dove	154	$308,761
Swifts	121	$32,016
Killdeer	98	$311,225
American/Eurasian Kestrel	85	$196,856
Eastern/Western Meadowlark	80	$389,421
Bats (Mammals)	71	$112,252
American Robin	70	$165,884
Total	1,427	$1,747,760

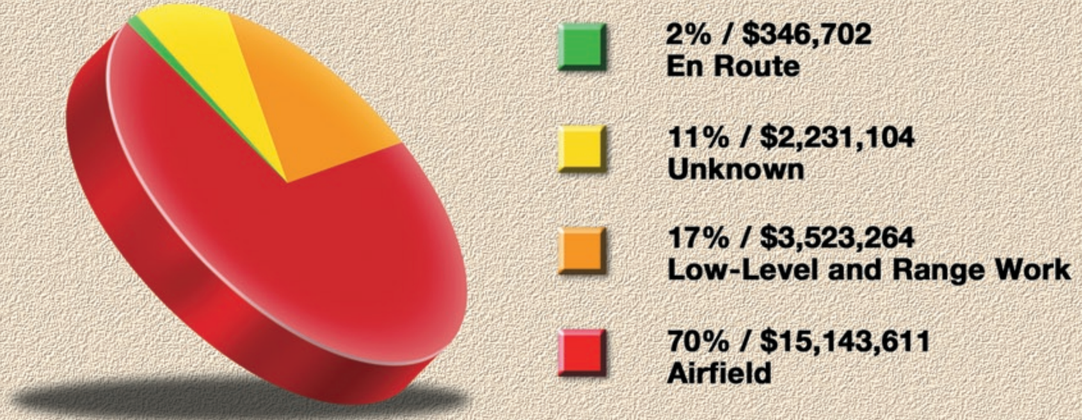
FY05 Top 10 Wildlife Strikes by Cost

Common Name	Cost	# Strikes
Canada Goose	$8,082,723	3
Laughing Gull	$1,661,417	13
Red-Tailed Hawk	$1,607,702	32
Lark Bunting	$975,250	3
Herring Gull	$910,488	10
Rock Dove/Pidgeon	$835,887	34
No Feather Remains Found	$722,619	102
Black Vulture	$634,398	24
Turkey Vulture	$621,160	21
Greater White-Fronted Goose	$313,172	1
Total	$16,364,836	243

FY05 Bird Strikes–Percent / Count / Phase of Operation



FY05 Bird Strikes–Percent / Cost / Phase of Operation



essary. The highest levels of bird activity normally occur during these hours as birds leave and return to their roosts. Avoiding flight operations during these periods can significantly reduce the chance of a bird strike."

It is important to remember that the probability of striking more than one bird is higher due to flocking behavior during dawn and dusk periods. Also, larger bodied migratory waterfowl are more likely to be active during these times. These flocks often go undetected due to reduced illumination. Wildlife strikes sustained during dawn and dusk periods accounted for only 19 percent of all strikes but posted 51percent of the total damage cost.

Of the 10 Class B mishaps, five occurred near the airfield, three occurred during low-level or range operations, and the remaining two were marked unknown. All but one Class B mishap occurring near the airfield involved flocks. A single pigeon caused $741,219 damage to a C-17. All Class B mishaps during low-level or range operations involved single strikes. Two of the three were large birds. A small Lark Bunting caused a compressor stall and $964,390 on a B-1.

The BASH team continues to research and harness technology to alert crews in real time to potential wildlife strikes. Funded plans exist to populate risk surfaces within the Bird Avoidance Model (BAM) and Avian Hazard Advisory System (AHAS) with the most current data available, to include historical bird movements detected by Next Generation Radar sites around the country. This additional data will make these systems more reliable as planning and front line advisory tools. A newly designed AF Form 853 is now available on the AF Publications and Forms web site. The new form should closely mirror how information is placed into the redesigned AFSAS while making it more user-friendly by following mission flow more closely. Every effort should be made to decrease the unknown category (nearly 45 percent).

Accurately reporting and identifying what wildlife our aircraft strike, and where and when the strike occurs, enables us to specifically research, develop, and enhance programs which will effectively and efficiently target and mitigate the hazard. Small Mobile Radar (SMR) testing is well underway at Tyndall AFB, with two additional units scheduled to soon be delivered to different bases. Different SMR operational concepts for fielding this real-time wildlife warning tool at home and deployed locations are being explored.

Maintenance

MAJOR JEFF TAYLOR
HQ AFSC/SEO

It's that time of year again. Time to look back and reflect on how we fared on our FY05 safety practices. In other words, how did we as a maintenance community keep from breaking things and hurting people. Well, there's good news and bad news. The good news is the overall number of maintenance-related mishaps is down. The bad news is there are still quite a few mishaps where we maintainers managed to break something or hurt someone. I wish I could say we were coming up with new ways of doing this, but unfortunately it's the same old things that keep coming up: not following T.O.s, taking shortcuts, improperly installed equipment, FOD, etc. Sound familiar? I know you've all heard mention of these items at a roll call or two.

The following paragraphs will provide examples of what we damaged, how we hurt ourselves, and, unfortunately, in one case lost the life of a fellow maintainer. We'll start with Class A mishaps followed by Class B and C, respectively.

Class A Mishaps

Overall, there were 4 Class A mishaps attributable to maintenance. A summary of each is listed below.

—B-1B Aft equipment bay fire. Ignition source was electrical arcing from a wire that was chafed from contact with the liquid cooler loop. The wiring was not routed per T.O. The result was $2.8M in damage.

—F-16D Engine failure. Crew ejected and aircraft was destroyed. Maintenance failed to install all 72 High Pressure Turbine (HPT) rotor blade damper seals. The result was the loss of a $23M aircraft.

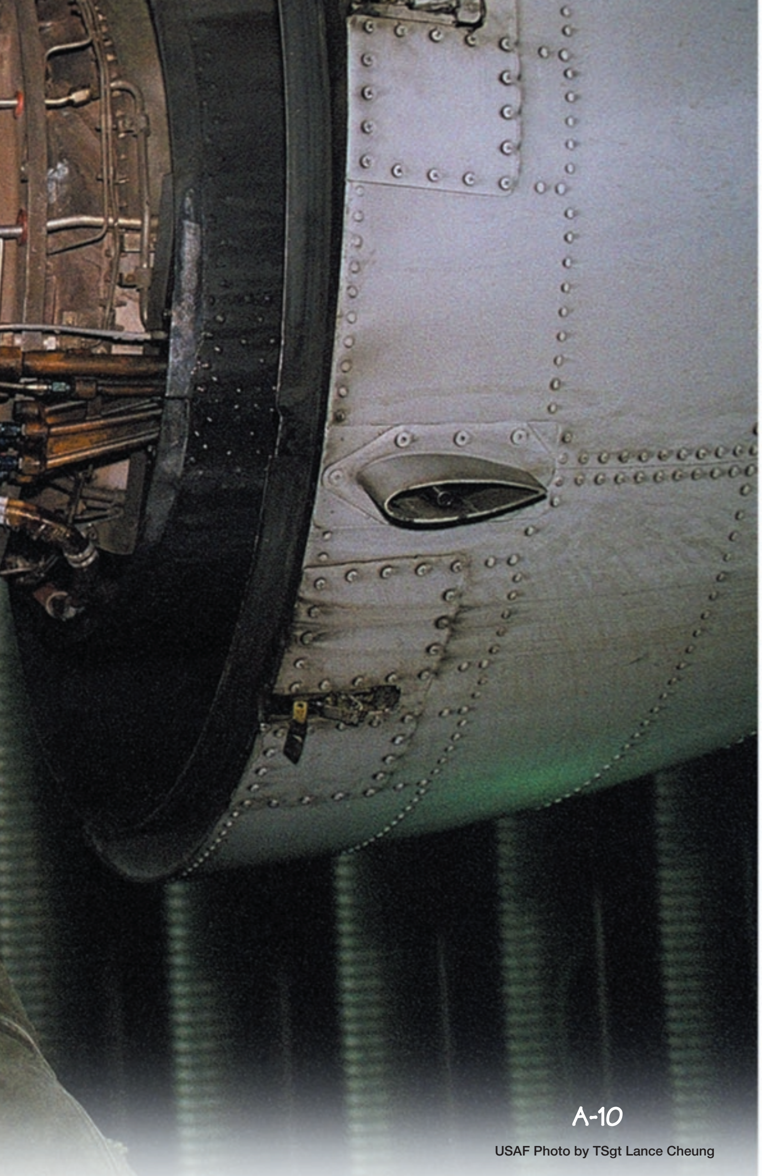
—F-16C Engine fire. The pilot had to eject and the aircraft was destroyed. Maintenance improperly shimmed and then over-torqued the augmentor fuel manifold. The result was another $19M aircraft lost.

—F-15C Maintenance Worker was fatally injured when he fell from the top of the variable inlet ramp. Maintenance stands meant to be used for safety were not in position. The result was the loss of an irreplaceable comrade.

Class B Mishaps

There were 5 Class B maintenance-related mishaps. A summary of each follows.

—C-17A HPT overtemp damage. The Turbine



A-10

USAF Photo by TSgt Lance Cheung

Cooling Air valve was wired closed preventing cooling air from reaching the HPT. This cost us $368K.

—F-15C tire failed on takeoff. The tire pressure was not properly serviced. This cost us $244K.

—E-3C Mission radar bearing failure. The bearing inspection interval was improperly managed. How much? $348K.

—KC-10A engine damage from excessive vibrations. Fan blades that were installed had improperly marked weight moments. Cost to us—$517K.

—An F-16C maintainer severed a thumb during flight control ops check. Miscommunication with an untrained/unqualified worker in cockpit who was working the side stick controller. One thumb equals $115K.

Class C Mishaps

There were way too many of these to list individually, 84 to be exact, so here's a synopsis.

—42 instances of system damage—dropped HUD x 2, hit several maintenance stands, canopy lowered on ladder, etc.

—11 incorrect part installation/procedures—fired carts during ops check, failed to install inner wheel bearing, miswired anti-skid, etc.

—10 tow incidents—hit hardstand, hit Dash-60, hit hangar doors, ran tug into aircraft, hit blast fence, etc.

—8 engine FOD—intake plug, FOD curtain hardware, comm cord, various panel fasteners, etc.

—8 dropped objects—engine cowling, escape slide, tailpipe, drag chute, and various panels.

—5 non-FOD engine damage—rotor during removal, dropped engine off of trailer, etc.

Lessons Learned

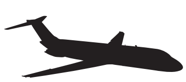
So, what can we learn from this information? Well, for one, thumbs are expensive. Humor aside, though, the important thing to take away from this is that we're still making the same mistakes year after year. We've all heard the topics of following tech data, tool control, forms documentation, PPE, and overall safety at roll calls, yet we continue to damage planes and equipment or hurt ourselves nearly on a daily basis. In the August 2004 edition of FSM, we published the "Top Ten Causes of Maintenance Mishaps." I have included the list here again because, as you can see from the previous examples, it is still relevant.

1. Failure to follow published Tech Data or local instructions.
2. Using an unauthorized procedure not referenced in Tech Data.
3. Supervisors accepting non-use of Tech Data or failure to follow maintenance requirements.
4. Failure to document maintenance in the AFTO Form 781 or engine work package.
5. Inattention to detail/complacency.
6. Incorrectly installed hardware on an aircraft/engine.
7. Ground support equipment improperly positioned for the task.
8. Failure to conduct a tool inventory after completion of the task.
9. Personnel not trained or certified to perform the task.
10. Performing an unauthorized modification to the aircraft.

Each and every one of you are extremely valuable members of our maintenance team. You work long, hard hours; rain or shine, hot or cold. We have all felt the pressures of a busy flying schedule or pending deployment. There never seems to be enough time to get things done. True, timelines in most schedules are tight, but consider this: If it is already tight, why risk exacerbating that by having to re-accomplish something along the way? Don't risk your professional reputation, and more importantly, yours or a coworker's health by ignoring tech date and safety. Know your job, execute it professionally, and don't tolerate those who don't.

Others:

USAF Photos



C-9

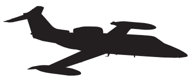
Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	0	0.00	0	0.00	0	0.00	0	0	3,008
5 YR AVG	0.0	0.00	0.8	6.02	0.0	0.00	0.0	0.0	13,288.4
10 YR AVG	0.1	0.57	0.4	2.28	0.0	0.00	0.0	0.0	17,573.1
LIFETIME CY68-FY05	3	0.33	6	0.67	1	0.11	3	3	897,855

C-12

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	0	0.00	0	0.00	0	0.00	0	0	4,759
5 YR AVG	0.0	0.00	0.4	9.70	0.0	0.00	0.0	0.0	4,122.8
10 YR AVG	0.0	0.00	0.2	4.56	0.0	0.00	0.0	0.0	4,385.0
LIFETIME CY75-FY05	2	0.48	3	0.72	1	0.24	2	6	417,491

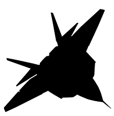
C-20

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	0	0.00	0	0.00	0	0.00	0	0	4,962
5 YR AVG	0.0	0.00	0.2	3.95	0.0	0.00	0.0	0.0	5,065.8
10 YR AVG	0.0	0.00	0.2	3.48	0.0	0.00	0.0	0.0	5,742.8
LIFETIME CY83-FY05	0	0.00	2	1.55	0	0.00	0	0	129,404



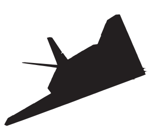
C-21

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	0	0.00	0	0.00	0	0.00	0	0	46,767
5 YR AVG	0.2	0.42	0.4	0.83	0.2	0.42	0.4	0.4	48,037.2
10 YR AVG	0.1	0.21	0.3	0.64	0.1	0.21	0.2	0.2	47,224.9
LIFETIME CY84-FY05	3	0.29	3	0.29	3	0.29	6	12	1,039,066



F-22

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	1	25.21	0	0.00	0	0.00	0	0	3,966
LIFETIME CY02-FY05	3	40.94	5	68.24	0	0.00	0	0	7,327



F-117

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	0	0.00	1	7.97	0	0.00	0	0	12,548
5 YR AVG	0.0	0.00	0.6	4.69	0.0	0.00	0.0	0.0	12,798.6
10 YR AVG	0.4	3.09	0.5	3.86	0.1	0.77	0.0	0.0	12,943.4
LIFETIME FY91-FY05	7	3.57	7	3.57	3	1.53	1	1	196,262

T-41

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	0	0.00	0	0.00	0	0.00	0	0	949
5 YR AVG	0	0.00	0	0.00	0	0.00	0	0	190
10 YR AVG	0	0.00	0	0.00	0	0.00	0	0	95
LIFETIME CY64-FY05	9	1.45	5	0.81	4	0.65	1	2	619,716

C-141

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	0	0.00	0	0.00	0	0.00	0	0	20,682
5 YR AVG	0.0	0.00	1.2	3.12	0.0	0.00	0.0	0.0	38,460.2
10 YR AVG	0.2	0.28	1.3	1.82	0.1	0.14	0.3	0.9	71,614.1
LIFETIME CY64-FY05	34	0.32	42	0.39	15	0.14	35	161	10,651,361

Note: These charts reflect flight-only mishaps, not all flight-related mishaps.

Trainers

T-1, T-6, T-37, T-38 AND T-43

USAF Photo by Kristin Royalty

LT COL MARK NUNN (T-1 AND T-43)
HQ AFSC/SEAI
MAJ TIM ARNOLD (T-6, T-37 AND T-38)
HQ AFSC/SEFF

Statistically, Air Force trainers had a good year, marred by a tragic midair with a civilian aircraft in which the civilian pilot was fatally injured and a T-37 destroyed. In addition to this Class A, there were two Class B mishaps, both in the T-38. This review will look at the three major mishaps and trends in the Class C and E incidents that had potential for more dire results.

T-37 Class A Midair Collision

A T-37 on an IFR clearance from the auxiliary field to home station collided with a civilian crop-duster flying VFR. The T-37 became uncontrollable and both pilots safely ejected. The civilian aircraft impacted the ground and the pilot was fatally injured.

The crew of the T-37 was in radio contact with Air Traffic Control (ATC) but received no traffic advisory because the civilian aircraft was not equipped with a transponder and its pilot had not established radio contact with ATC. The aircraft were operating in Class E airspace, which does not require either radio contact or a transponder.

The Accident Investigation Board (AIB) found the following:

—First, the aircrews of both the T-37 and the civilian aircraft failed to "see and avoid" each other in sufficient time to prevent the mishap.

—Second, the civilian pilot was flying at 5000 feet MSL instead of a VFR hemispheric altitude appropriate for his direction of flight.

This mishap reinforces the need to visually clear your flight path any time you are not in IMC conditions, *regardless* of your type flight plan/clearance.

All the above information was obtained from the Accident Investigation Board report. To read the privileged Safety Investigation Board (SIB) report for this, or any other mishap, contact your safety officer.

T-38

A T-38 struck a large bird while flying low-level, causing an in-flight shutdown of, and extensive damage to, the No. 2 engine. The crew safely recovered the aircraft to the home station.

In addition to this Class B, there were 13 Class C bird strikes in the T-38 last year. Birds are a major threat to our flying operations. The Air Force suffers an average of $35 million damage each year and has lost several aircraft and crewmembers over the years due to bird strikes.

It is critical that we mitigate the risks of hitting birds through active BASH plans, proper use of the Bird Avoidance Model (BAM) and Avian Hazard


Advisory System (AHAS), reporting bird activity, and accurately establishing and heeding the bird watch condition at airfields, ranges and other operating areas.

The only other trainer Class B in FY05 was an intentional gear-up landing when part of the right main landing gear departed the aircraft during a touch-and-go. The mishap crew continued the touch-and-go, confirmed their status with a chase ship and landed gear up at an out base.

T-37

Despite flying two-and-a-half times as many hours, the T-37 had fewer Class C mishaps than the T-6 in FY05, with 11 compared to 14 in the T-6. Examining the Class C and E events, there are a few trends worth mentioning in the mighty Tweet.

There were 22 instances of smoke in the cockpit. Eight of these were the result of a failed starter garlock seal, a known problem which generally does not cause any further damage or difficulty in flying the aircraft. Failed air conditioning turbines were the culprit in four other cases, twice causing damage in excess of $20,000. The lesson from these relatively benign incidents is make sure your life support equipment fits and functions, because at least 22 T-37 crews had to rely on theirs last year.

As any Tweet FAIP can tell you (even ten years after his last flight), the T-37 has the fastest G onset rate in the Air Force inventory. Armed with no G-suit and very little experience, 18 students were reported to experience G-induced loss of consciousness (GLOC). A very thin line (and an IP) separates these Class E events buried deep in AFSAS from being Class A disasters.

The third trend to address at the inexpensive level is runway departures. There were four of these last year. One of these aircraft hit a runway remaining marker and exceeded the $20K mark. We all remember a runway departure with much worse consequences just two years ago. IPs, make sure you know when you need to give verbal inputs and when you should take the jet.

T-1

For FY05, the T-1 community posted another banner year in regard to aviation safety, with no Class A mishaps for the second consecutive year and no Class B mishaps. Class C mishaps continued to decline in FY05, with only three recorded mishaps as opposed to five recorded in FY04. Two of the Class C mishaps resulted from aircraft bird strikes, while the third mishap was a result of an aircraft maintenance personnel injury.

The only appreciable increase for the T-1 was in the Class E incidents reported in FY05, as compared to FY04. Over 200 Class E events were reported, as compared to only 54 in the previous year. This large increase in Class E events can be directly attributed to more accurate reporting of BASH events within AVSAS. 175 bird strikes were reported in FY05 as Class E events and included in the overall Class E data. Bird strike events in FY04 (178 Class E BASH events) were not included in the overall Class E data, but reported in a separate graphic in the FY04 EOY update. If you break out the bird strike data from the other Class E events in FY05, only 24 non-BASH-related Class E events were reported, which is 56 percent less than last year’s statistic of 54 events.


USAF Photos

USN Photo by Photographer's Mate 2nd Class Daniel J. McLain

Smoke and Fumes-related events continue to plague the T-1, with 17 events reported in FY05. Four of the events resulted from failed Audio Amplifiers (a recurring problem in the T-1).

Runaway/uncommanded trim failures accounted for four Class E events in FY05. Three of these incidents were attributed to failed right relay panels, while the other failure was a result of a failed pitch trim actuator motor. These failures may be indicative of an emerging problem within the T-1's right relay panel and bear watching, but overall, the T-1 community continued to improve on its already excellent safety record with a superb showing in FY05.

T-43

The T-43/CT-43 continues its trend as one of the safest Air Force assets in the inventory. Over the operational lifespan of the aircraft that began in 1974, only one Class A, six Class B and six Class C mishaps have been recorded. This MDS has not logged a single Class A or Class B mishap in the last nine years, and only logged a single Class C mishap in FY05 due to a bird strike to the No. 1 engine. Reported Class E events for FY05 were at a nine-year low, with only 11 reported incidents. Much of this success can be attributed to the fairly benign mission of the T-43, and the fact that this MDS logs less than 5000 operational flying hours annually, but the great news is that they continue to build upon an almost spotless safety record from year to year.

T-6

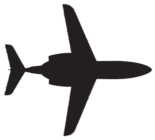
For the first time in three years, the T-6 fleet avoided a Class A or B mishap. Great job! As mentioned in the T-37 blurb, the T-6 did have a relatively high Class C rate, although five of those incidents were maintenance injuries which, while still important, will not count as aviation mishaps in the future. Of course, there are still some valuable nuggets we can cull from the Class C and E mishaps.

The T-6 engine was the culprit in three of the Class Cs, with one crew getting the chance to excel as a glider pilot. The oil system is number one on the JPATS Joint Priority List, and improved oil servicing procedures are being implemented as you read this. Statistically speaking, the PT-6A is a reliable engine, but it's your *only* engine…so stay aware of your options.

Two trends in the Class E range are the Attitude and Heading Reference System (AHRS) and physiological episodes. There were six AHRS failures, fortunately all in VFR conditions. Relatively low threat when you can see the ground, this would be a challenging EP in the soup.

Physiological episodes in the T-6 demonstrate the value of technology: Despite equally inexperienced students (relative to the T-37), there were zero reported GLOCs in the T-6 last year. Unfortunately, even a pressurized cockpit doesn't make flying while congested, a safe practice. There were seven reported ear/sinus block incidents in FY05. You may feel you can't afford to go DNIF and fall behind in the syllabus, but one of these episodes can put you on the sidelines far longer.

Keep up the good work in FY06 and let's keep learning from the little ones. Fly Safe!



T-1

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	0	0.00	0	1.00	0	0.00	0	0	103,604
5 YR AVG	0.2	0.20	0.8	0.79	0.0	0.00	0.0	0.0	101,409.4
10 YR AVG	0.1	0.11	0.8	0.86	0.0	0.00	0.0	0.0	93,469.5
LIFETIME FY92-FY05	1	0.10	8	0.81	0	0.00	0	0	985,703

T-6

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	1	1.29	0	0.00	0	0.00	0	0	77,666
5 YR AVG	0.4	0.90	0.8	1.79	0.2	0.45	0.4	0.4	44,632.8
LIFETIME FY00-FY05	3	1.34	4	1.79	2	0.89	2	2	224,034

T-37

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	1	0.66	0	0.00	1	0.66	0	0	151,411
5 YR AVG	0.8	0.46	0.0	0.00	0.8	0.46	0.2	0.4	174,027.4
10 YR AVG	0.6	0.34	0.0	0.00	0.6	0.34	0.1	0.3	176,292.5
LIFETIME CY56-FY05	138	1.03	31	0.23	136	1.02	27	78	13,393,746

T-38

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	0	0.00	2	1.37	0	0.00	0	0	146,456
5 YR AVG	1.0	0.69	1.0	0.69	1.0	0.69	0.2	0.4	144,386.8
10 YR AVG	0.6	0.42	0.8	0.56	0.6	0.42	0.1	0.4	141,823.8
LIFETIME CY60-FY05	194	1.47	97	0.73	187	1.42	76	138	13,214,638

T-43

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	0	0.00	0	0.00	0	0.00	0	0	4,645
5 YR AVG	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.0	4,698.2
10 YR AVG	0.1	1.47	0.0	0.00	0.1	1.47	0.2	3.5	6,808.1
LIFETIME CY74-FY05	1	0.29	6	1.77	1	0.29	2	35	357,526

Note: These charts reflect flight-only mishaps, not all flight-related mishaps.

UAS

MAJ CHRISTOPHER P. FROESCHNER
HQ AFSC/SEFO

USAF Photo

In FY05, the Air Force continued its increased reliance on Unmanned Aerial Systems (UAS) and the critical resources they bring to the table in several arenas that include the Global War on Terror, intelligence collection, and even border defense. As a result, there were more mishaps in FY05 than in the recent past.

In addition to a growing myriad of smaller unmanned systems, the UAS community is composed of four main platforms: the RQ/MQ-1 Predator, the RQ-4 Global Hawk, the Tethered Aerostat Radar System (TARS), used in detection and monitoring of illicit drug trafficking and low-level radar surveillance, and the unmanned version of the QF-4 Full Scale Aerial Target (FSAT).

RQ/MQ-1 Predator

The MQ-1 Predator is a medium-altitude, long-endurance UAS that is remotely piloted via satellite or line-of-site data link. The MQ-1's primary mission is interdiction and conducting armed reconnaissance against critical, perishable targets. The vehicle is equipped with a color nose camera that is generally used by the pilot for control in flight and on the ground, a day variable-aperture TV camera, a variable-aperture infrared camera (for low light/night), and a synthetic-aperture radar for looking through smoke, clouds or haze.

In FY05, the Predator UAS had six Class A mishaps, one Class B, one Class C, and 10 Class E events. Most of the mishaps occurred during the first half of the fiscal year, and two of the Class A mishaps and the single FY05 Class B mishap occurred during the pilot-controlled landing phase of operations. Unlike the Global Hawk, the Predator does not have an auto takeoff and land system, and as a result the Predator has had its share of mishaps involving pilot error in trying to control a very sensitive unmanned vehicle in the final stages of landing. Changes to syllabus training that made takeoff and landing a special qualification for experienced pilots has resulted in a success story of no Predator mishaps in the take-off or landing phases since the changes.

One Class A and the only Class C mishap this year occurred during taxi operations. In one instance, the Predator received significant damage when it suddenly accelerated and ran off the runway before it was stopped. In another instance, the Predator departed paved surface during a 180-degree reverse turn and suffered damage. The other Class A mishaps suffered by the Predator program in FY05 involved a satellite link interruption that resulted in loss of command to the vehicle and its crashing in a remote area, an in-flight fire that resulted in burning the airframe until it no longer was controllable and crashed, and one Predator suffered an in-flight loss of thrust that resulted in a crash landing off a paved surface that destroyed the vehicle.

Of the 10 reported Class E events, a significant trend was noted in the area of Near Mid-Air Collisions (NMACs). In the highly congested AOR environment, there have been four NMACs involving Predator vehicles. Part of the problem involves the operating altitudes of Predators and the close vicinity that puts them with Special Ops vehicles. Airspace control, high air traffic volume, and areas of restricted radar coverage are noted problems in the AOR, and due diligence is required of all pilots and crew operating manned or unmanned aircraft and UAS in the area.

RQ-4 Global Hawk

Cruising at extremely high altitudes, the RQ-4 Global Hawk can survey large geographic areas with pinpoint accuracy and give military decision-makers the most current information about enemy location, resources and personnel. The Global Hawk is significantly different from the RQ-1, in that the Predator is a remotely piloted vehicle (RPV), while the Global Hawk is not. 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 the Ground Control Stations, and those controls are executed through autonomous software. Once mission parameters are programmed into Global Hawk, the UAS can autonomously taxi, take off, fly, remain on station capturing imagery, return and land. Ground-based operators monitor vehicle health and status, and can change navigation and sensor plans during flight, as necessary.

This year, the Global Hawk had one Class B mishap, one Class C, and two Class E events. The Class B mishap occurred when a damaged oil scavenge pump resulted in the pilot commanding the vehicle to turn around and land at a preplanned emergency divert airfield. While the vehicle is an auto-land platform, the pilot needed to direct a go-around on the first attempt in order to re-set the landing parameter for auto-land to work properly on the second attempt. The Class C mishap occurred when an RQ-4 experienced engine difficulties in support of an OPERATION ENDURING FREEDOM mission and was commanded to divert. The Global Hawk made a successful autonomous landing, but a departure from prepared surface resulted in damage to the right wing, main wheel/tire damage, and a sensor window covering. One of the two Class E events involved nose landing gear trunion damage that resulted when a sudden stop occurred during a turn. The other event involved an uncommanded in-flight engine shutdown that resulted in an uneventful autonomous return to base utilizing the auto-land feature, 45-minute battery backup and 25 to 1 glide ratio of the vehicle.

QF-4 and Aerostats

There were no Class A, B, or C mishaps for the unmanned version of the QF-4 FSAT during FY05.

For the Aerostat in FY05, there were two Class A mishaps that destroyed three aerostat vehicles and one Class B mishap that destroyed the payload support structure and windscreen. All three of these mishaps occurred during severe weather. One Aerostat was destroyed when lightning struck the tether of the vehicle during retrieval procedures. The aerostat broke away and the flight director purposely deflated the vehicle to keep it from harming others on the ground as it was off its tether. Two other Aerostats were destroyed during Hurricane Dennis after the payloads of both vehicles had been secured, but the empennages and hulls were not collected before mandatory evacuation forced workers away from the site. The lone Class B damage occurred as a result of heavy, varying winds that led to payload support structure collapse.

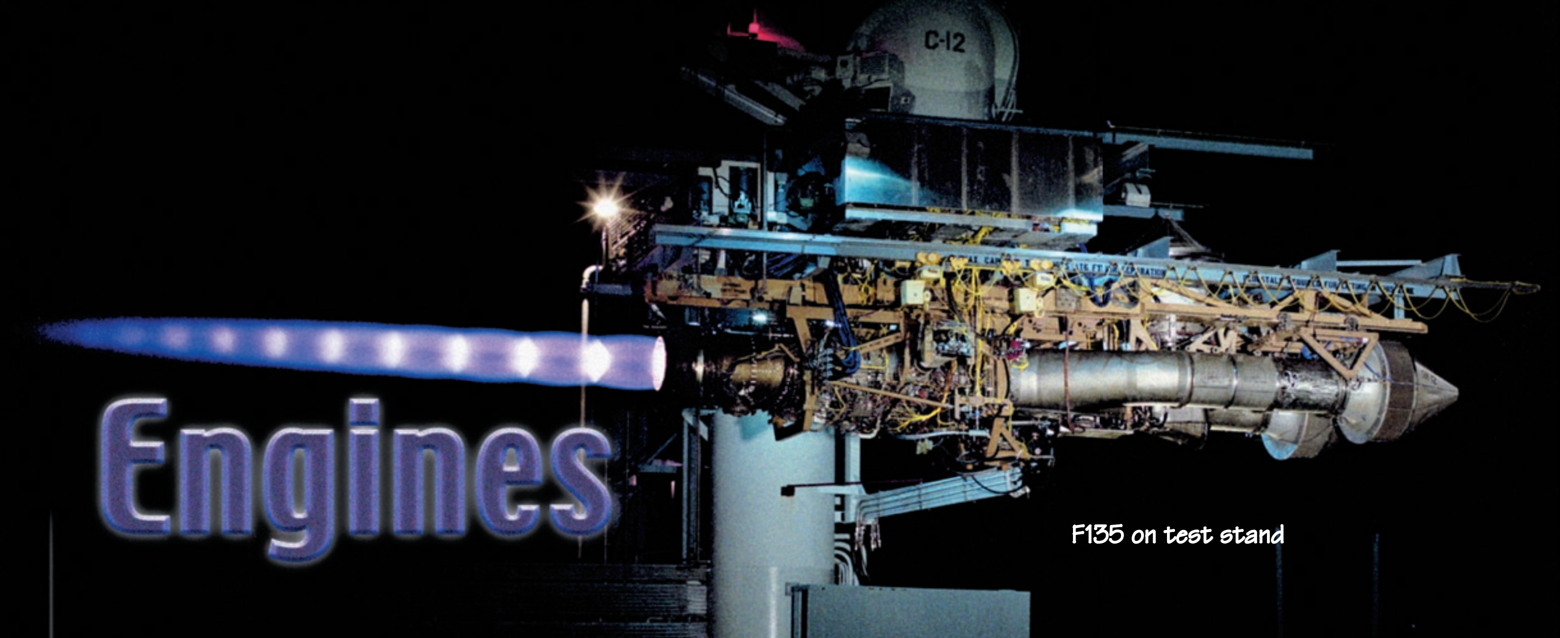
M/RQ-1

Year	Class A		Class B		Destroyed		Hours
	No.	Rate	No.	Rate	A/C	Rate	
FY05	6	75.09	1	12.52	5	62.58	7,990
5 YR AVG	3.4	17.37	0.4	2.04	3.0	15.32	19,577.3
LIFETIME FY97-FY05	22	19.67	3	2.68	20	17.88	111,874

RQ-4

Year	Class A		Class B		Destroyed		Hours
	No.	Rate	No.	Rate	A/C	Rate	
FY05	0	0.00	1	0.00	0	0.00	?
5 YR AVG	0.4	121.58	0.2	60.79	0.4	121.58	329.0
LIFETIME FY00-FY05	2	121.58	1	60.79	2	121.58	1,645

Note: These charts reflect flight-only mishaps, not all flight-related mishaps.



F135 on test stand

Imagery Courtesy of Authors

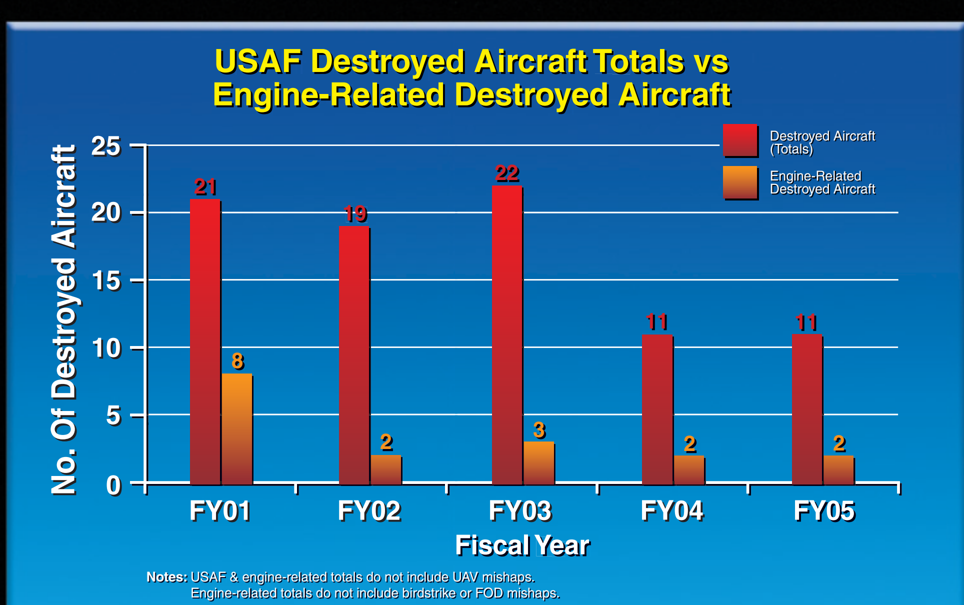
CAPT BRIAN MCDONALD
BILL BRADFORD
RICH GREENWOOD (Pratt & Whitney)
BOB WOLFF (General Electric)
HQ AFSC/SEFE

Like the stock market on any given day, the FY05 safety statistics for the USAF engine community were a mix of ups and downs. Most importantly, we returned to zero fatalities attributed to engine malfunctions! Also, on positive notes, the number of engine-related destroyed aircraft held steady at the historic low of two, and engine-related Class A flight mishaps dropped to seven. The discouraging news to report is that many of these failure modes have a history that, unfortunately, we repeated. Worse yet, lapses in maintenance discipline within Jet Engine Intermediate Maintenance (JEIM) shops were found to be the root cause of the two destroyed aircraft. We will take a closer look at these statistics, and some noteworthy mishaps, to see why the FY05 "engine safety market" was mixed.

Destroyed Aircraft

In terms of engine-related destroyed aircraft, we have been so successful at driving down the numbers over the past five years that there is no room for error if we expect to continue that downward trend. Figure 1 should be easily recognized by our faithful end-of-year article readers. It compares the total number of USAF destroyed aircraft to those that were engine-related. These tallies do not include unmanned air vehicles (UAV). The figure shows that the two destroyed aircraft in FY05 matched the FY04 total. Two engine-related destroyed aircraft, the lowest total in a fiscal year, has been accomplished just twice before in recorded USAF history. Great job repeating that feat for a third time! In contrast with last year, when we lost two twin-engine aircraft, both aircraft this year were single-engine F-16s. Both mishaps gave the engine community an eerie sense of déjà vu and an unfortunate reminder that failure to follow technical order (T.O.) guidance can have severe consequences. For the benefit of future mishap prevention, we will share the details of these mishaps, taken from their Accident Investigation Board (AIB) reports, and ask that you reflect on what was found. Beware of thinking, "It'll never happen to me."

Figure 1

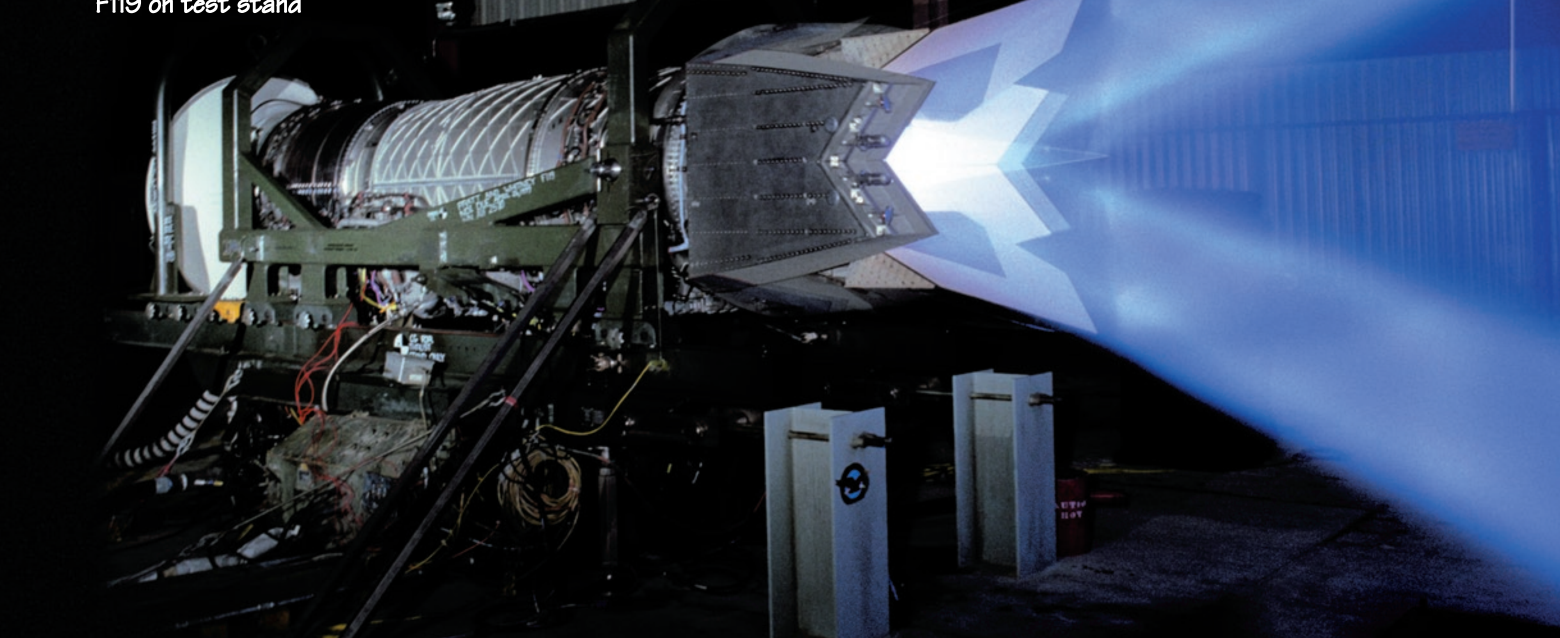


An F-16 two-ship departed on a Basic Fighter Maneuver (BFM) mission off the Atlantic coast. Just as the flight went “feet wet” over the ocean at an altitude of 19,300 feet, the F-16D front seat pilot heard a loud bang, felt the aircraft shudder, and noticed a significant loss of thrust. His backseater confirmed something very much out of the ordinary had occurred. The pilot immediately turned to parallel the coastline in an attempt to find a suitable airfield while avoiding populated areas. Multiple engine restart attempts were unsuccessful. The flight lead contacted Air Traffic Control to declare an in-flight emergency and coordinate for a flameout landing at the nearest divert airfield. At approximately 10 miles out, the pilot of the stricken aircraft relayed to his flight lead, “We’re not going to make it.” They selected a barren mud flat and marsh along a river they had followed inland to bail out and ditch the aircraft. Following successful pilot ejection, the F-16D slowly rolled right, impacted the marsh, and erupted into a ball of fire. The Coast Guard picked up the two uninjured pilots approximately nine minutes after ejection. A nearby boater, who was quick-on-the-draw with a digital camera, snapped some remarkable photos of the final seconds.

The ensuing teardown and technical analysis of the F110-GE-129 engine quickly revealed the culprit. Upon removal of the damaged high pressure turbine (HPT) blades, a team of engineers discovered all 72 HPT rotor blade damper seals were missing. The purpose of the small, thin HPT damper seals is to prevent high cycle fatigue cracking of the turbine blades through vibrational damping. Without the damper seals, the HPT lasted 415 engine operating hours, or one calendar year, since it was rebuilt by the JEIM Section. The AIB Executive Summary stated, “There is clear and convincing evidence that the HPT blade failure was caused by the required blade seals not being installed in the HPT rotor assembly during scheduled maintenance.”

For two reasons, this mishap was particularly disheartening. First, the governing T.O. work packages that instruct JEIM technicians on HPT build-up and installation contained explicit cautions and inspections to preclude omission of the damper seals. The caution read, “CAUTION: Missing HPT rotor blade seals will cause HPT rotor blade failure.” Additionally, there was a high-quality picture, from a first-person perspective, of a visual inspection for the presence of the damper seals between the HPT rotor blade platforms. Strict adherence to the T.O. would have saved a $23 million aircraft. The second disheartening fact is that the USAF lost an F-16C in 1989 for the exact same reason! In that mishap, all 72 HPT rotor blade damper seals and the aft retainer seal wire were not installed in the HPT assembly during the last rotor buildup at depot. The engine lasted just 242 engine operating hours. It is very likely the T.O. cautions and inspections cited above were incorporated as a direct result of that mishap.

The second engine-related destroyed aircraft in FY05 flew its final mission as part of an F-16 two-ship BFM sortie in the Cheyenne Military Operating Area in southeast Colorado. Approximately 29 minutes into the flight, after the third BFM engagement, the pilot received an audible warning tone, engine fire warning light, dual flight control light, and other caution lights. After terminating the maneuvers, the pilot began a climb and proceeded directly to the closest divert airfield. The aircraft engine instruments indicated normal operation, however, the wingman visually confirmed a fire in the left speed brake area. After jettisoning the centerline fuel tank, the pilot climbed to reach an altitude of 31,000 feet MSL at approximately 35 miles from the field and then reduced the throttle to idle. The pilot maneuvered for a straight-in to the divert field with a 6300 foot runway.


F119 on test stand

The aircraft touched down just left of centerline, 300 feet down the runway at 170 Knots Calibrated Airspeed (KCAS) and the pilot initiated wheel braking. No appreciable braking was noted and the aircraft began a slow veer to the right despite pilot attempts to stay on the runway. At approximately 1950 feet remaining and 140 KCAS, the pilot successfully ejected with minor injuries prior to the aircraft departing the prepared surface. The aircraft departed the runway onto the infield paralleling the runway and remained upright until the nose landing gear tire impacted a concrete manhole just prior to the connecting taxiway at the departure end of the runway. The aircraft then became airborne for 100 feet before striking the ground again. This impact collapsed the nose gear, obliterated the cockpit, and liberated the nose cone. The aircraft came to rest wings-level, 100 yards from the departure end of the runway. There was no post-impact fire.

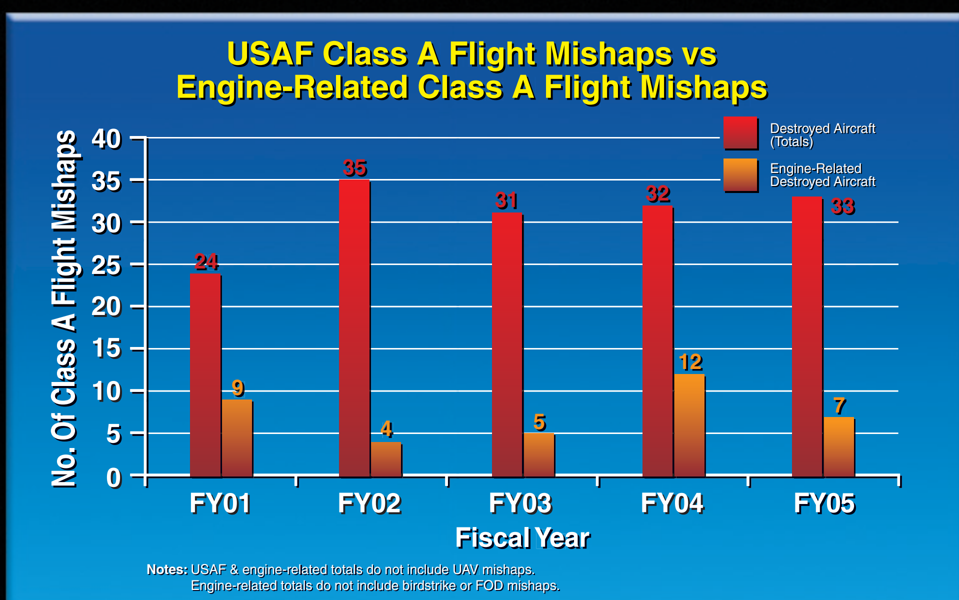


Figure 2

After the F110-GE-100 engine was removed from the aircraft, investigators determined the cause of the engine fire light, audible warning, and reported fire. The augmentor fan fuel manifold was found fractured at the 10 o'clock position. This breach in the fuel line acted like a blowtorch in the engine bay. Unfortunately, lapses in maintenance discipline by the JEIM shop were a factor in this mishap, just as they were in the previous F-16D mishap. Technical representatives from Tinker AFB issued a report that stated incorrect torque, almost twice that directed in the T.O., and improper shimming of the fan fuel manifold during installation resulted in additional stress at the manifold/distributor flange and the manifold/augmentor case flange. These additional stresses led to high cycle fatigue fracture of the manifold just 44 engine operating hours after installation. To help eliminate the possibility of future events, technical data was revised by adding an in-process inspection (IPI) to verify proper installation and thickness of washers between each fuel manifold mount bracket and duct boss.

There is a saying in the safety world, "There are no new mishaps out there, only repeats of past lessons learned." That's right; we've suffered a previous mishap very similar to this one, too, and, in an eerie fluke of foreshadowing, we discussed it in detail in a previous year-end article. Jump in your time machine and turn back the date to when an F-16D experienced a similar fuel leak in the augmentor section, resulting in Class B fire damage. That mishap was caused by a disconnected augmentor fan/core spraybar that allowed leaking fuel to become an ignition source in the engine bay. How did it become disconnected? Over time, the two undertorqued attaching bolts backed out and allowed the spraybar to dislodge from the distributor. Although the failure mechanism differed from the augmentor fan fuel manifold mishap, the root cause was the same—failure to properly torque bolts in accordance with technical data.

In addition to the common thread of T.O. violations between the two FY05 destroyed aircraft and their predecessors, these and several other recent mishaps have brought to light a seemingly widespread deficiency in documentation of engine work packages for engines undergoing in-shop maintenance. Engine work packages/folders are records used to document maintenance actions and should tell the story of what actions were accomplished, how they were accomplished, who performed them, and when they were completed. This is not the place to be brief. In fact, only good can come for the maintenance community from highly detailed annotations of the work done by each shift. Shift changeovers will be more confident and any oversights are more likely to be caught before damage or disaster occurs.

Class A Flight Mishaps

Despite the negatives inherently found in two destroyed aircraft, the final tally of engine-related Class A flight mishaps was a positive for FY05. Figure 2 compares the total number of USAF Class A flight mishaps to those that were engine-related over the last five years. As mentioned earlier, the seven FY05 engine-related mishaps in this category represented a drop from FY04 back to a total typical of FY01-03. Four of the five engine-related, dol-

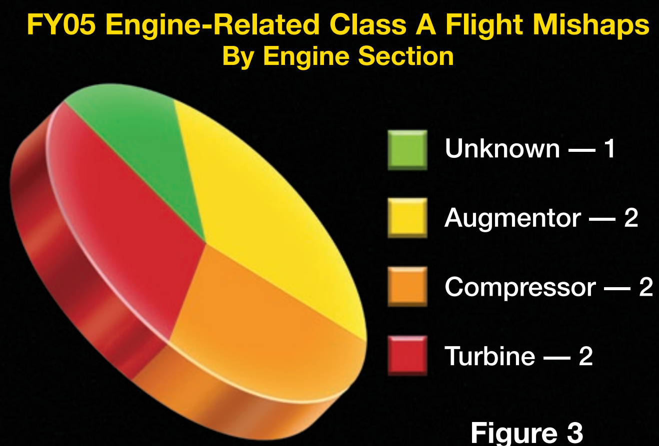


Figure 3

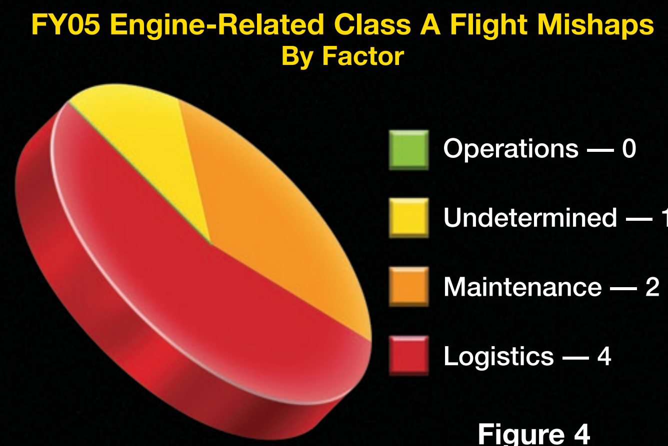


Figure 4

lar-value Class A mishaps last year involved large aircraft, including the KC-10 refueler, C-17 airlifter, and B-1 bomber. This is good news for the fighter/attack community with less powerplant redundancy; however, this statistic appears to be a recent upward trend for "big motor" aircraft. There were no engine-related Class A flight mishaps for three- and four-engine aircraft during the year-pair FY02 and FY03, as compared to 13 for the year-pair FY04 and FY05. Potential drivers could be:

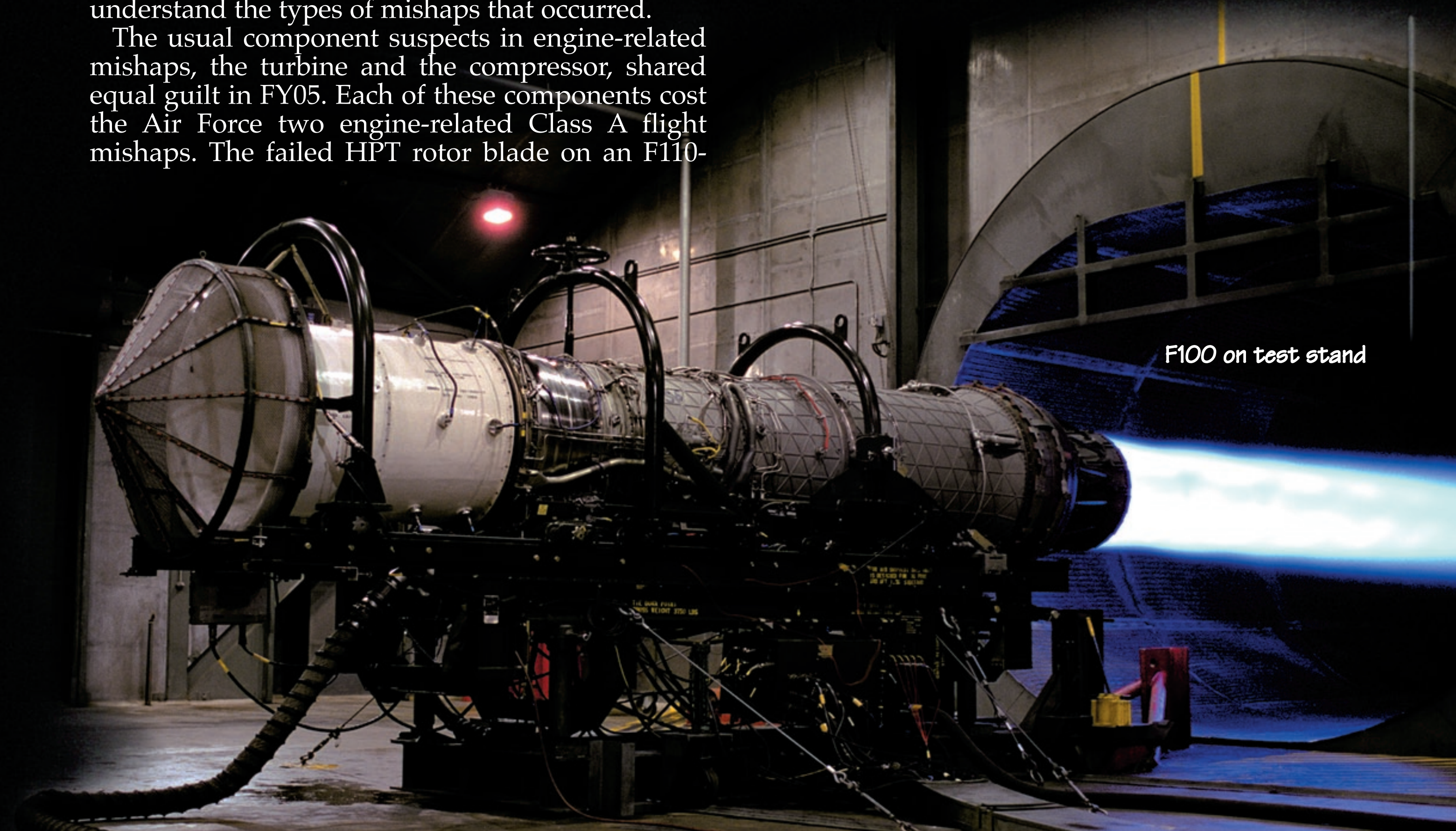
(1) The average cost to repair newer, high-bypass ratio turbofan engines breaking the $1,000,000 Class A threshold.

(2) Particularly costly failure modes occurring recently.

(3) The heavies were just really lucky in FY02 and FY03.

This is a trend to watch as the future unfolds. In the meantime, we will examine the seven FY05 engine-related Class A mishaps in several ways to fully understand the types of mishaps that occurred.

The usual component suspects in engine-related mishaps, the turbine and the compressor, shared equal guilt in FY05. Each of these components cost the Air Force two engine-related Class A flight mishaps. The failed HPT rotor blade on an F110-GE-129 engine discussed earlier and a cracked HPT nozzle mid-cone on an F103-GE-101 engine (KC-10) made up the turbine section failures. The compressor section failures included a fractured sixth-stage blade on an F117-PW-100 engine, a well-known failure mode to the C-17 fleet, and a fatigue-fractured second-stage blade on an F101-GE-102 engine (B-1). Figure 3 depicts these data in a pie chart, along with one undetermined engine failure and two mishaps in which there were failures in the augmentor section. Having an equal number of mishaps attributed to the augmentor as the turbine and compressor in a fiscal year was somewhat unusual; however, seven Class A mishaps was not a large sample size—thankfully. We already covered the F-16C augmentor manifold failure. The second involved an F-15C that returned to base with one augmentor duct and nozzle completely missing! (That dropped-object report must have been an interesting read.) We will briefly summarize each



F100 on test stand

F-16 Engine-Related Destroyed Aircraft Statistics						
Fiscal Year	FY03		FY04		FY05	
Engine	Aircraft Losses	FY03 Rate	Aircraft Losses	FY04 Rate	Aircraft Losses	FY05 Rate
F100-PW-220	2	1.69	0	0.00	0	0.00
F100-PW-229	0	0.00	0	0.00	0	0.00
F110-GE-100	0	0.00	0	0.00	1	0.73
F110-GE-129	0	0.00	0	0.00	1	2.19
All Engines	2	0.58	0	0.00	2	0.63

Table 1

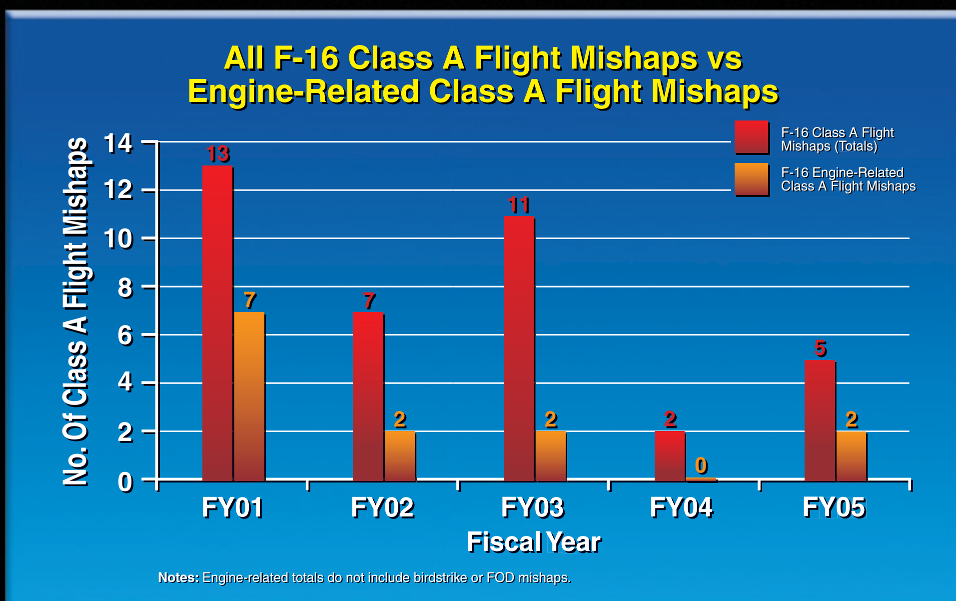


Figure 5

of the dollar-value Class A mishaps later. The four large aircraft mishaps are described in their respective engine manufacturer's sections.

In keeping with tradition, we also present Figure 4 that categorizes the Class A mishaps by factor—logistics, maintenance, and operations. Kudos to the operations community—pilots were not found causal for any of these. Four mishaps were found to have their root cause in logistics (design, manufacturing, etc.), the leading factor in FY05. Although maintenance (depot, field, and contractor) was cited as the factor for half as many as logistics, both mishaps attributed to maintenance resulted in destroyed aircraft. In this respect, maintenance fell into the same unenviable position operations held in FY04. We must be vigilant in preventing the pressures of the flight line and flight environment from translating into destroyed aircraft and lost lives.

Fighter Summary

We normally dedicate a portion of our year-end article to reviewing the statistics of our high-performance, single- and twin-engine fighters, namely the F-16 and F-15, since engine failures put them at greatest risk for catastrophic consequences. The F-22 will soon be featured in this summary, but its operational flying hours are still too few to compare with its very mature fighter brethren. Much of the FY05 story for the fighters has already been revealed, so comparison to recent history is the focus here.

F-16

By incurring two engine-related destroyed aircraft in FY05, the F-16 engine family lost an opportunity to post two consecutive years with no destroyed aircraft. Table 1 shows this statistic, as well as the other engine-related destroyed F-16 totals and rates for the past five fiscal years. Based on the snapshot shown in Table 1, the five-year cumulative USAF rate for destroyed F-16s was 0.77. Constituting that rate were the five-year cumulative rates for the General Electric and Pratt & Whitney-powered F-16 fleets registering at 0.88 and 0.59, respectively. These rates were calculated as the number of destroyed F-16s, divided by the total flying hours of interest over the five years, and then multiplied by 100,000. To put these rates in context, the 10-year average annual destroyed aircraft rate for the entire USAF (all aircraft) was 0.85. Considering the fact that destroyed F-16s, historically, have been a major contributor to the USAF rate, the recent General Electric and Pratt & Whitney rates are impressive! The other closely tracked statistic is represented by Figure 5, which shows the number of engine-related F-16 Class A flight mishaps next to the F-16 fleet totals. FY04 was certainly a tough act to follow, with no engine-related Class A mishaps. The two engine-related Class A flight mishaps recorded in FY05, both destroyed aircraft, matched the totals in FY02 and FY03. Over the five-year timespan presented, engines were responsible for 34 percent of all F-16 Class A flight mishaps.

F-15

Dare we say, destruction of F-15s due to engine failures is becoming a thing of the past? (Please, knock on wood!) FY05 was the seventh consecutive year the F-15/F100 engine family achieved a flawless engine-related destroyed aircraft record. We included Table 2 to accentuate that feat of safety. Only the safety community would be so proud to show a

F-15 Engine-Related Destroyed Aircraft Statistics						
Fiscal Year	FY03		FY04		FY05	
Engine	Aircraft Losses	FY03 Rate	Aircraft Losses	FY04 Rate	Aircraft Losses	FY05 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

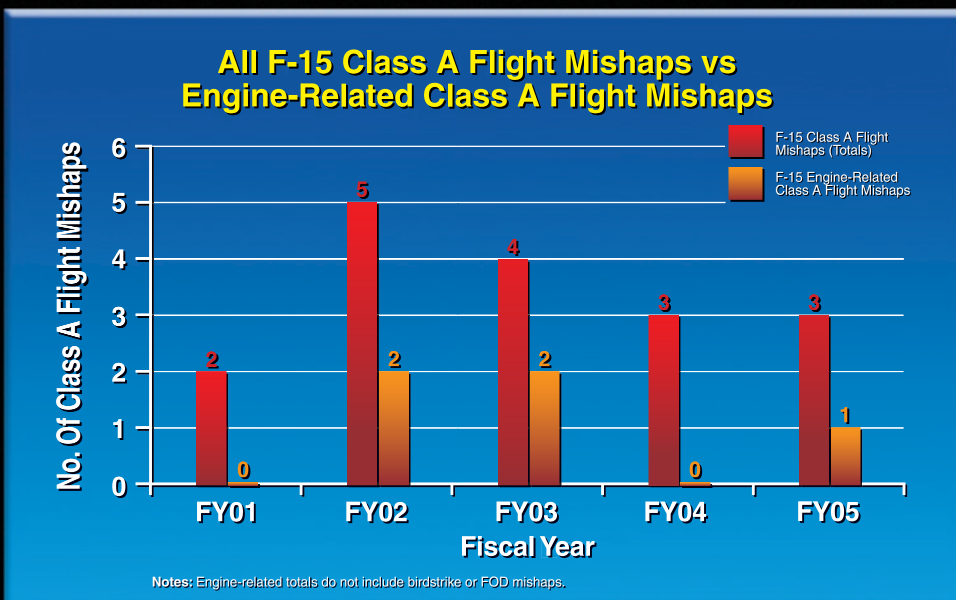


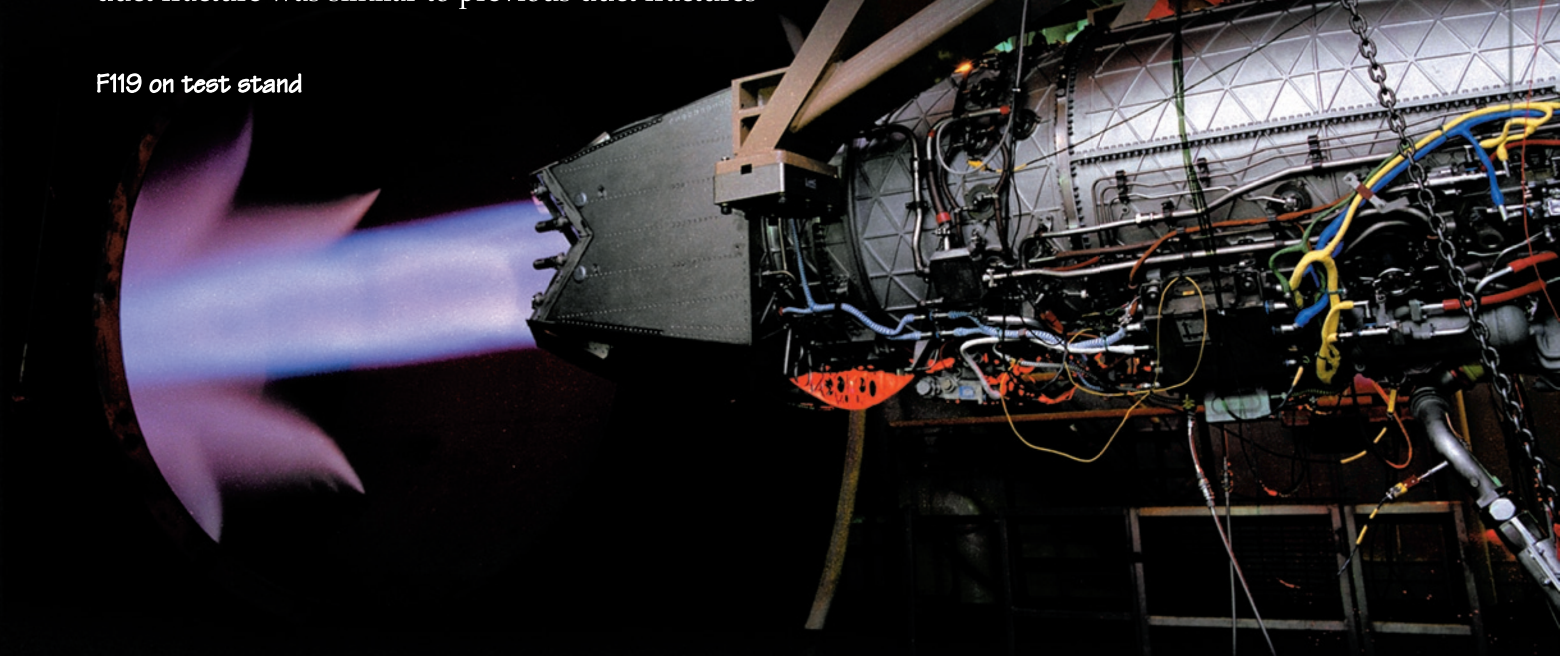
Figure 6

bunch of zeros. A bit more interesting is Figure 6, which compares engines to all causes of F-15 Class A flight mishaps over the last five fiscal years. Just one of these in FY05 was engine-related. It involved an F-15C powered by an F100-PW-220 engine.

During a routine training mission, the No. 1 engine augmentor duct and nozzle separated from the engine and was expelled out the back of the aircraft. There was slight collateral damage to the aircraft and the rest of the engine, but the aircraft was recovered safely. Investigation discovered that the duct fracture was similar to previous duct fractures in the F100-PW-220-powered fleet. Corrective action for this failure mode is replacement of the old-style sheet and stringer-constructed duct with a new chemically-milled duct. Aircraft that are not yet retrofitted with the new duct require a fluorescent penetrant inspection of the old-style duct every 1200 engine cycles. All F100-PW-220-powered F-16s have been retrofitted with the new duct, in addition to approximately 90 percent of the F100-PW-220-powered F-15s. The retrofit of the F100-PW-100-powered F-15s, which have historically showed a lower risk of augmentor liberation, is at 28 percent. Risk of continued operation of the unmodified F-15s is well below established USAF risk management thresholds.

This single mishap in FY05 matches the average number of F-15 engine-related Class A flight mishaps over the previous four years.

Despite our zealous quest for zero mishaps, current Propulsion Product Group Manager (PPGM) policy, influenced by budgetary constraints, necessarily accepts some residual risk to maintain fleet readiness. Last year's F-15 Class A augmentor separation was an example of that residual risk manifesting itself as a mishap.



F119 on test stand

Other Pratt & Whitney Engines

To recap, there were no destroyed aircraft in the Pratt & Whitney-powered USAF fleet in FY05 and just two dollar-value Class A mishaps. Those involved an F-15C, as described above, and a C-17, as described below.

F117-PW-100 (C-17)

The aircrew was conducting a go-around from an assault landing during a training mission when they heard a loud bang followed by an aircraft yaw to the right. Noting a loss of thrust and high exhaust gas temperature on the No. 4 engine, they shut it down and returned to base for an uneventful three-engine landing. Teardown and inspection of the engine revealed a fractured sixth-stage compressor blade root, a known problem in the F117-PW-100 engine. This was the first time the damage cost from this failure mode broke the Class A threshold.

The F117 engine community has determined the most probable cause of these fractures is high-frequency blade vibration driven by aerodynamic instabilities. Changes made to compressor hardware and variable vane schedules over the last several years were successful in reducing, but not eliminating, these fractures. The operational risk of future fractures remained above the PPGM-established risk thresholds for non-recoverable in-flight shutdowns. Pratt & Whitney completed a blade redesign incorporating increased airfoil thickness, different material, and a blade root anti-gallant and is now awaiting approval pending successful validation. If approved, the new blades may be introduced into the F117 engine fleet as early as July of 2006 and bring the risk of future incidents below PPGM threshold.

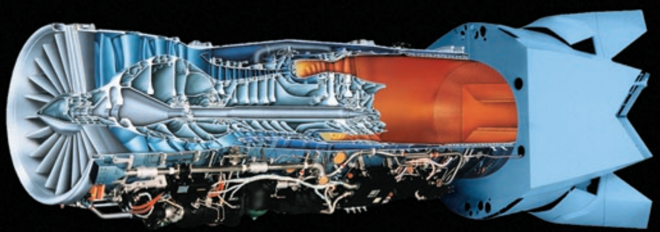
Other General Electric Engines

In addition to the two destroyed F-16s, there were three other engine-related Class A flight mishaps involving General Electric engines in FY05. One involved a KC-10; the other two involved B-1s, as described below.

F103-GE-101 (KC-10)

The mishap occurred during a planned go-around as the aircrew was initiating a gear retraction. As the gear handle was placed in the up position, the crew heard a loud bang and the aircraft immediately yawed to the right. At the same time, engine fan speed decreased rapidly and the exhaust gas temperature exceeded the indicator. In addition, control tower personnel notified the aircrew of flames shooting from the No. 3 engine exhaust. The aircrew initiated and completed the "Engine Fire/Severe Damage" checklist and performed an uneventful engine-out approach and landing.

Post-flight inspection revealed an engine-confined failure with no foreign object damage. Because the high-speed compressor could not be rotated, local maintenance personnel were unable to perform a borescope inspection. Subsequent teardown, analysis, and laboratory investigation determined the first-stage HPT nozzle mid-cone failed. For reasons unknown, a crack appeared to have started along a weld on the mid-cone. The little physical evidence that may have existed to explain the origin of the crack was destroyed as the crack grew. As a result, no root cause for this failure could be determined. General Electric launched an engineering investigation on the CF6-50 first-stage high-pressure turbine nozzle support with a view to identify potential issues and appropriate actions.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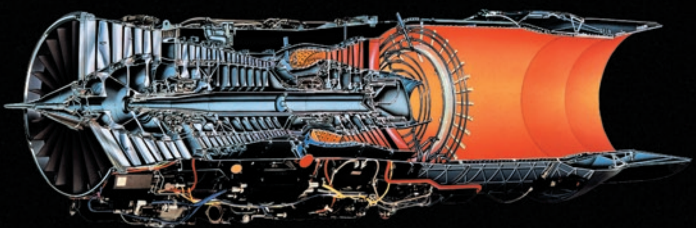
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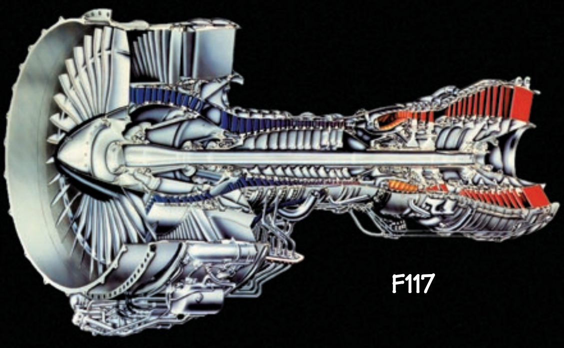
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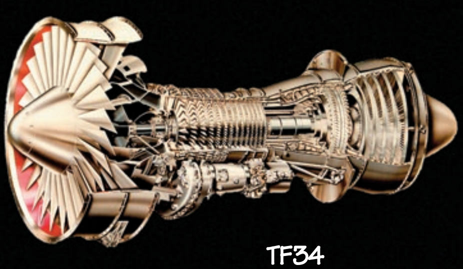
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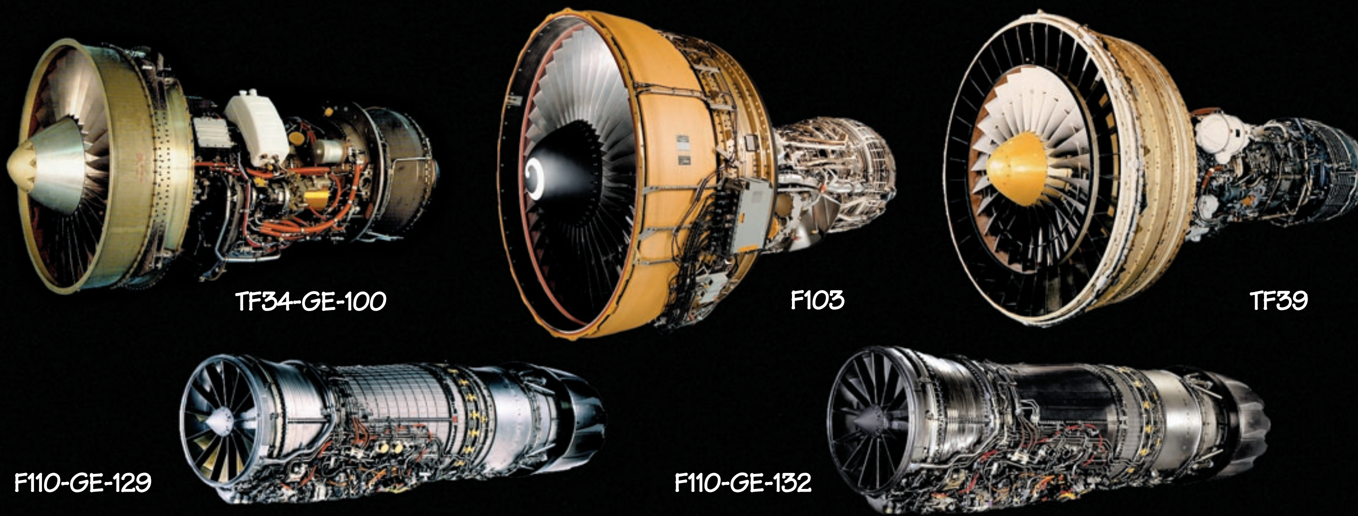

F101-GE-102 (B-1)

The first of two dollar-value Class A flight mishaps in the B-1 community occurred as the aircrew was descending for low-level currency training. As the crew increased the throttles during level-off, they heard a loud bang and observed a spike in engine turbine temperature. The Central Integrated Test System indicated an engine stall. In accordance with technical order procedures, the aircrew declared an in-flight emergency and performed an uneventful engine-out approach and landing.

Teardown and inspection revealed this engine experienced fatigue fracture and separation of a second-stage high-pressure compressor blade. Unfortunately, General Electric and OC-ALC engineers were unable to identify a single root cause for the blade fatigue. However, fracture features were similar to that seen when a one-per-revolution stimulus is present or by edge of contact (EOC) cracking. One-per-revolution excitation occurs when either a variable stator vane (VSV), or sub-component of that system, is misaligned. This, in turn, causes the blade to vibrate back and forth every time it passes the misaligned VSV. In this situation, the blade suffers higher stresses than normal and, over time, can fail due to fatigue. EOC cracking results from high shear stress at the pressure face contact line between the blade and disk dovetails. A design change was made in the late 1980s that modified the high-pressure compressor short dovetail design with a longer dovetail to reduce this EOC stress. The F101 engine is introducing this design and one-per-revolution stator fixes at the Engine Structural Integrity Program overhaul.

The second B-1 mishap occurred during a routine training sortie. Following an engine anomaly involving the No. 4 engine, the aircrew declared an in-flight emergency, shut down the affected engine, and completed a successful return to base. At the time of this writing, the safety investigation for this mishap had not been completed.

Summary

The opening argument was that FY05 was a "mixed market" for engine safety. Let's recount our key gainers and losers to see if that holds true:

FY05 Engine-Related "Gainers"

—No fatalities.
—Repeated historic low of two destroyed aircraft.
—Seventh consecutive year without a destroyed F-15.
—40 percent fewer Class A mishaps than FY04.
—No Class A mishaps attributed to operations.

FY05 Engine-Related "Losers"

—Both destroyed aircraft caused by failure to follow T.O. guidance.
—Both destroyed aircraft caused by the same mistakes made in the past.
—Large aircraft dollar-value Class A mishaps are on the rise.

Indeed, engine safety in FY05 was mixed. There were many positives that indicate our tireless efforts are making a difference. There were also several causes for concern, both at the backshop level and system level. Our hope with this year-end article is to highlight past, high-cost engine mishaps and broad statistics to facilitate awareness and future mishap prevention.

Probably the most effective way to a safer future is information distribution and vigilance at the grassroots level. If you participate in a safety investigation, share your newfound knowledge with colleagues in a manner respectful of safety privilege. If you think something is not being done properly, do yourself or your wingman a favor by slowing down, paying closer attention, and/or double-checking. While prevention of mishaps is sometimes thankless, and often unknown, the Air Force depends on it.

Helicopters

USAF Photo

LT COL THOMAS ROY
HQ AFSC/SEFF

Overall, FY05 was another mixed year in the Air Force helicopter world in terms of the benchmark Class A Flight mishap rate. The MH-53 and the UH-1 experienced an exceptional year, with no Class A mishaps. However, HH-60s were far above five- and ten-year averages with five Class A flight mishaps. Class A mishaps tragically claimed the lives of two Airmen. The USAF helicopter community again trended above five- and ten-year averages in Class B and C mishaps.

	Class A FY04/05	Class B FY04/05	Class C FY04/05
H-1	0/0	0/1	5/3
H-53	2/0	1/6	13/11
H-60	0/5	1/3	7/14
Total	2/5	2/10	25/28

MH-53

The MH-53 experienced no class A mishaps, six Class B mishaps, and 11 Class C mishaps in FY05. Two Class B mishaps were the result of powerplant malfunctions, two resulted from damage during landings to unimproved areas, one resulted from a serious injury while working a GAU-2 Mini-Gun malfunction, and finally, the most notable Class B mishap resulted from a tail rotor ground strike during upgrade training at an improved field.

The MH-53 powerplant malfunctions were the result of a condition familiar to the community, compressor rub. Fortunately, and largely due to the expeditious and appropriate actions of the aircrew, neither of these malfunctions resulted in any airframe damage or injuries.

Although both MH-53 landing mishaps were the result of distinctly different factors, both occurred during extremely demanding, low-illumination tactical missions. The first was the result of landing on an unseen block barrier at an abandoned airfield, while the second resulted from a failure mode familiar to MH-53s, nose gear collapse. The aircraft, while executing a dust-out landing, contacted a solid earth berm amidst the soft soil, and the aircraft's nose gear failed. As has happened several times in the past, the fairly minor nose gear failure rendered the aircraft non-flyable due to flight control tube impingement, greatly increasing the extent of the mishap.

The tail rotor strike, which occurred during landing roll-out to an improved landing strip, resulted in shards from the compromised tail rotor blades penetrating the aircraft's cabin, very seriously injuring a crewmember seated in the aft left troop seat.

USAF Photo by MSgt Jonathan F. Doti H-1

H-1

The H-1 experienced no Class A, one Class B and three Class C mishaps. The community's sole Class B mishap involved an uncontained turbine failure during continuation training. During manual fuel operations, the engine experienced a compressor stall that progressed into a catastrophic engine failure. The aircraft landed safely, with no airframe damage or injuries. Mishaps during manual fuel operations, both in training and on functional check flights, have become a significant trend in the H-1 community.

HH-60

The HH-60 experienced five Class A, three Class B and 14 Class C mishaps in FY05, well above historical averages.

One Class A mishap occurred during an extremely demanding night operational mission. The aircraft, upon reaching the terminal area, encountered sudden and unexpected brown-out conditions while in an out-of-ground effect (OGE) hover. Steep ridgelines were on all sides, there was low illumination the helicopter hadand limited power. Rotor-to-terrain contact led tragically, to an airman losing his life in this mishap.

Another Class A mishap occurred during tactical training at a range facility. While working a GAU-2 Mini-Gun malfunction in an OGE hover, the crew elected to execute a rearward hovering reposition in order to land and further evaluate the gun malfunction. Shortly after initiating the rearward hover, power demand exceeded power available, and the aircraft entered an unrecoverable descent. The aircraft received significant structural damage upon ground contact.

A third mishap involved main rotor to tail pylon contact during brown-out landing procedural training to an improved landing strip. Contact resulted from significant aft cyclic input remaining following collective reduction. The aircraft received significant structural and power train sudden-stoppage damage.

A fourth mishap occurred during departure from an improved area. The high operating weight aircraft departed into a significant tailwind on a very hot day. Upon initiating a left turn during the departure, more fully aligning the aircraft with the tailwind and increasing the power demand, the aircrew heard the aircraft's low rotor horn sound. In an effort to regain rotor RPM, collective was reduced, manual control was taken of both engines, and a right turn was initiated. This allowed additional power to be produced and decreased power demand. Following these actions, the rotor RPM came back, and with the engines still in manual control, started cycling off the engines' over-speed protection system. This cycling was mistaken to be engine compressor stalling, and direction was given to retard the throttles. The throttle reduction resulted in an unrecoverable descent to ground impact, causing extensive aircraft structural damage.

A fifth mishap occurred while on a continuation training mission in a mountainous area. While on an extended departure from an improved, high-density altitude airfield, the aircraft entered a right turn in significant winds. During the turn, a descent rate developed and the helicopter was not recovered before ground impact. Tragically, this mishap also cost an Airman his life.

USAF Photo

Conclusion

Lessons learned this year are again difficult to roll-up. There were no common threads throughout all FY05 Class A and B mishaps. Statistically, FY05 trended well above previous years' averages in Class A, B and C mishaps.

To address the materiel failures of FY05, the lead MAJCOMs and the USAF logistics community are actively developing and fielding mitigation measures. The risks associated with the extremely demanding low-level environment in which we operate are high; therefore, continued focus on two basic risk mitigation tactics is imperative.

1. Thorough and continuous operational risk management (ORM).

2. Increased emphasis on basic airmanship.

From mission planning, all the way through mission completion, a mission's benefit must be continually weighed against its risk. Frequently, a mission with an acceptable risk/benefit ratio during mission planning evolves into far too risky a scenario during execution. Once over the fence, this continual risk/benefit evaluation, and the ultimate go/no-go decision largely falls onto the persons with the most situational awareness: the aircrew and, ultimately, the aircraft/mission commander. Is it darker, dustier, hotter or higher than anticipated during the initial risk assessment? What is the cost of mission cancellation, and does it outweigh the increased risk? ORM must not stop before the rotors do!

A significant concern from FY05 was the lapse in basic airmanship seen in several Class A, B and C mishaps. A common thread among these mishaps was a highly detailed and choreographed tactical plan, briefed in great detail, but lacking adequate focus on basic airmanship. Our environment is far too demanding to allow ourselves to fall short on performance planning, aircraft systems knowledge, basic helicopter flying skills, etc. Our helicopter community needs to adhere to the USAF-wide focus on the basic airmanship to prevent such mishaps from recurring.

This article and its sanitized mishap synopses do not give the operator full insight needed to prevent future mishaps. If you are an operational helicopter crewmember, it is imperative that your local safety shop provide you with all necessary insight on these and other past mishaps so that you may learn from them and prevent further losses of critical assets necessary to maintain our combat capability. Fly safe!

H-1

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	0	0.00	1	3.78	0	0.00	0	0	26,481
5 YR AVG	0.2	0.95	0.2	0.95	0.2	0.95	0.0	0.0	21,159.8
10 YR AVG	0.4	1.94	0.1	0.49	0.4	1.94	0.0	0.0	20,579.9
LIFETIME CY59-FY05	54	3.22	15	0.90	40	2.39	21	52	1,674,632

H-53

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	0	0.00	5	53.02	0	0.00	0	0	9,430
5 YR AVG	2.0	17.95	2.6	23.34	0.6	5.39	0.2	1.0	11,140.2
10 YR AVG	1.3	10.62	1.5	12.26	0.4	3.27	0.1	0.6	12,236.7
LIFETIME CY66-FY05	38	7.64	30	6.03	23	4.62	25	86	497,614

H-60

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY05	5	18.84	1	3.77	2	7.54	0	2	26,538
5 YR AVG	1.8	6.98	0.4	1.55	0.8	3.10	0.4	1.6	25,786.2
10 YR AVG	1.1	4.22	1.0	3.83	0.6	2.30	0.6	2.0	26,079.0
LIFETIME FY82-FY05	18	4.47	4	0.99	11	2.73	11	42	402,777

Note: These charts reflect flight-only mishaps, not all flight-related mishaps.

USAF CLASS A FLIGHT MISHAPS

FY06 Flight Mishaps
(Oct 05-Jan 06)

9 Class A Mishaps
0 Fatality
2 Aircraft Destroyed

FY05 Flight Mishaps
(Oct 04-Jan 05)

12 Class A Mishaps
1 Fatalities
4 Aircraft Destroyed

09 Oct	An F-16C departed the runway on landing rollout; pilot egressed safely.
20 Oct ✶	An F-22A ingested an NLG safing pin into the #2 engine; no intent for flight.
21 Oct ✶	An MQ-9L landed short of runway; gear collapsed.
24 Oct ✶	An Aerostat was destroyed during a hurricane.
28 Oct	An F-16C departed the runway on landing rollout; pilot egressed safely.
02 Nov	A C-5A had a #2 MLG bogie fire after landing.
17 Nov	A C-17 had a #4 engine compressor stall and fire.
28 Nov	An F-16C departed the runway on landing rollout; pilot egressed safely.
06 Dec	An A-10A had a landing gear collapse on takeoff.
13 Dec ✈	A T-38 had a bird strike; aircraft crashed, pilots ejected safely.
13 Dec	An F-15C had a compressor stall and overtemp on takeoff roll; takeoff aborted.
17 Jan ✈	An F-15C crashed into the ocean; pilot ejected OK.

Editor's note: The 17 Nov mishap was upgraded from Class B.

- 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 22 Jan 06**.

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"We are not looking for the minimum risk; we are looking for the right risk."

MAJOR GENERAL LEE MCFANN, USAF
Chief of Safety

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