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U.S. AIR FORCE

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MESSAGE FROM THE CHIEF of SAFETY

Vector Check - Where Are We? Where Are We Going?

Congratulations! FY06 was the safest year in Air Force aviation history with all-time record lows in aviation-related fatalities, destroyed aircraft, and Class A mishaps.

In FY06, the Air Force recorded 19 Class A aviation mishaps, eight destroyed aircraft (down from 11 in FY05) and one aviation fatality. Our mishap rate plunged to an all-time low of 0.90 Class A mishaps per 100,000 flying hours (compared to 1.49 in FY05).

Safety is critical to efficient military operations -- it's really about maximizing combat power. Continuous safety awareness at all levels -- from commanders to individual Airmen -- is the key. Anytime equipment or an Airman is lost, it amounts to a reduction in our readiness and combat capability. Although 2006 was our best year ever, it is important to remember that mishaps are preventable and we must not let our guard down.

Last year's safety success can be tied directly to three factors: great leadership at all levels, heightened safety culture and the implementation of risk mitigation strategies by our Airmen. It comes down to embedding a safety mindset into everyday routines -- it comes down to personal responsibility. Do it right and people will follow your example. This enhances our Air Force safety culture more than anything we do, and passes it on to the next generation of Airmen!

Again, congratulations on a job well done! ★★

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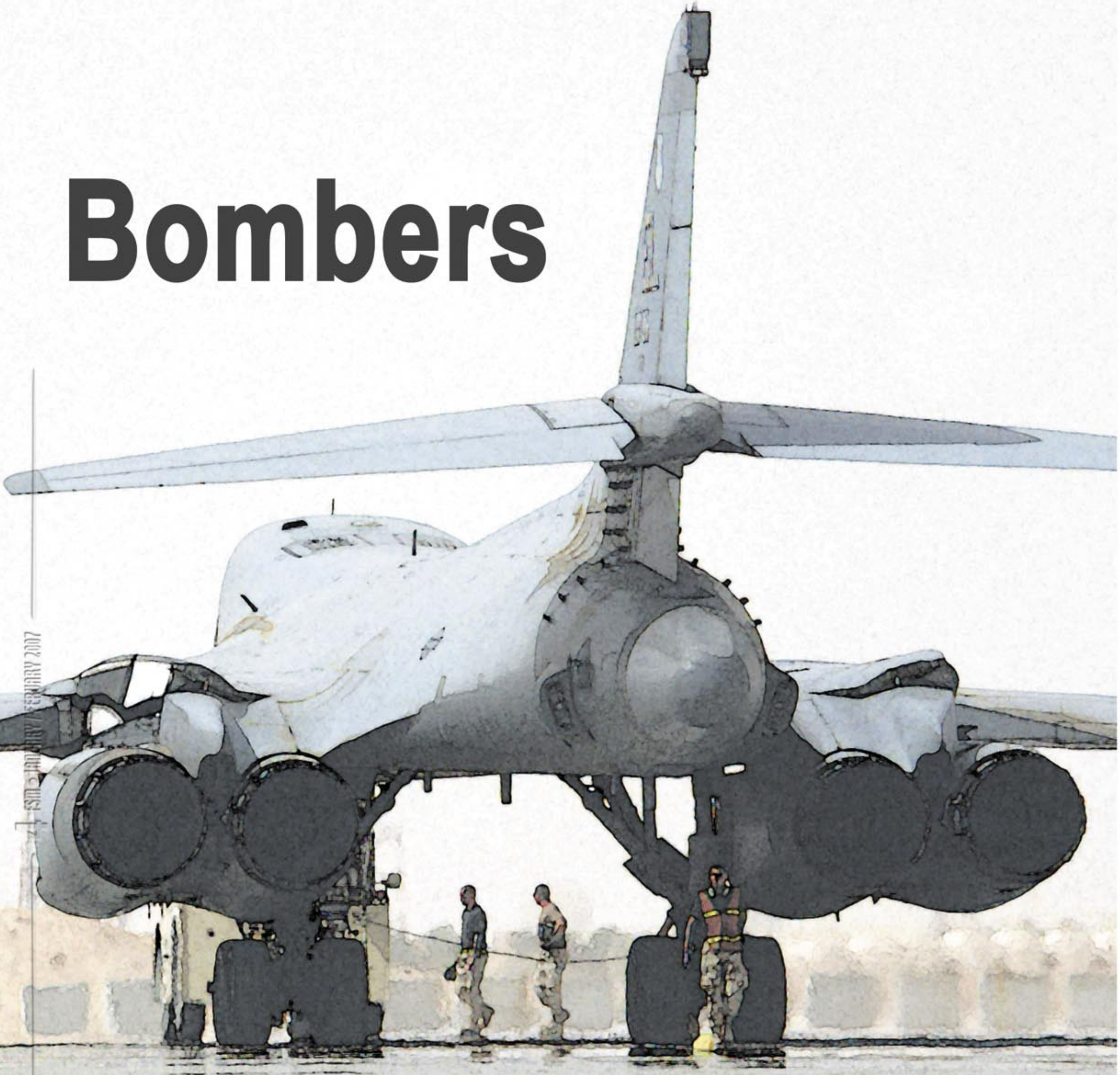
Bombers



USAF Photo by SSgt Cherie A. Thurlby
Photo Illustration by Dan Harman

MAJ RANDY RUSHWORTH
HQ AFSC/SEFF

The bomber community enjoyed one of the best overall safety years ever in FY06 while continuing to advance worldwide operational capabilities in support of combatant commanders. There were only two Class A mishaps in the community during FY06, down from six in FY05. The 11 total community-wide Class B mishaps represented a decrease from 21 in FY05. Propulsion-related mishaps and events continued as a focal point for bombers in FY06, a prominent factor in all three weapon system mishap and event statistics.

FY06 B-1B Safety Review

The B-1 community experienced lower mishap rates in every class for FY06. Class A mishaps were down from four to two, with Class Bs down from 12 to nine. Class C mishaps were down from 29 to 27 in FY06 with a total of 79 Class E events reported, down from 106 in FY05. Propulsion-related mishaps and events continued to dominate B-1 reporting for FY06 with eight Class Bs, 13 Class Cs, and 30 Class Es. Focused mishap prevention programs and persistent leadership in FY06 enabled the B-1 community to reverse a three-year trend of rising mishap statistics.

Class A Mishaps

Both FY06 bomber Class A mishaps occurred in the B-1 community. One Class A mishap was flight related, but not rate producing for flight. A B-1 on a CONUS training mission released a practice munition which landed within the planned impact area on a local range. The munition's spotting charge started a fire that became uncontrollable due to existing hazards and inadequate fire suppression resources. The resultant wildland fire burned for about 12 hours and affected approximately 26,000 acres of grazing and agricultural land.

During the fire, privately owned structures, farm equipment, fencing, wells, livestock, animal feed, and crops were damaged or destroyed. The fire resulted in no human fatalities, although one civilian firefighter suffered a broken ankle. Improved range firefighting equipment and communications, as well as more focused risk management, were directed to lower the risk of uncontrollable range fires.

The second FY06 bomber Class A resulted when a B-1 landed with its landing gear retracted during recovery from an operational mission. The mishap crew egressed the aircraft successfully with one crewmember suffering a minor back injury. Damage to the aircraft was estimated at $7.9 million including additional damage to the runway. The mishap once again highlighted the absolute and uncompromising value of aircrew leadership, crew resource management, and checklist procedures in maintaining safe operation of valuable combat assets.

Class B Mishaps

Of the nine B-1 Class B mishaps in FY06, eight were propulsion-related, and one involved a right Structural Mode Control System (SMCS) vane departure in flight. While flying low-level, the B-1's SMCS began vibrating excessively. The aircrew reset the SMCS and the vibrations continued. The aircrew then turned off the SMCS, and the vibrations ceased after several seconds. The aircrew elected to turn the SMCS back on for the remainder of low-level, and the vibrations did not return. The aircrew continued their mission and landed uneventfully at home station.

After parking, the aircrew was informed by the crew chief that the right SMCS Vane (SV) was missing, and there was additional damage to the aircraft. The SV spanner nut and Locking Tab Washer (LTW), normally used to retain the SV, were found loose in the SMCS actuator compartment. The LTW inner tang was found broken and the spanner nut showed no damage to its threads. The Spanner Nut (SN) was found loose during a previous phase inspection and subsequently, re-torqued. During the re-torque, the spanner nut wrench made contact with the LTW and fractured the inner tang.

Sometime between the re-torque and the time of the SV departure the SN loosened and both the SN and LTW came off the SV shaft. The Mishap SV (MSV) was most likely held in position for an undetermined time by pressures applied directly to the SV shaft through the SMCS actuator fitting. The forces holding the unretained MSV in place finally broke loose during low-level, allowing the SV to depart the aircraft.

Two one-time inspections revealed a fleet-wide problem involving loose stack-up, broken hardware and spanner nuts and locking tab washers installed backward. Improved maintenance procedures, technical orders, and increased inspection intervals were directed toward mitigating the hazards existing within the SMCS system.

The eight FY06 B-1 propulsion-related Class B mishaps and their causes have been addressed through General Electric's Service Life Extension Program (SLEP) and the USAF Engine Technical Review Program. F101-102 Low Pressure Turbine (LPT) stage one blade liberation, number three bearing seizure, and number four roller bearing failure have continued to be highlights of USAF and GE's hazard mitigation efforts.

Class C and E Mishap/Events

The B-1 experienced 27 Class C mishaps and 79 Class E events in FY06. Propulsion-related mishaps/events and bird strikes accounted for the substantial majority of Class Cs (13 and 1) and Es (30 and 36). Four additional Class C mishaps were brake related, and six were related to dropped objects or control surface damage. In contrast, FY05 produced 50 propulsion and 49 BASH Class Es. The lowered Class C and E rates were a testament to the improving prevention efforts with B-1 maintenance and operations.

FY06 B-2 Safety Review

The B-2 community completed FY06 without a single Class A mishap, and only one Class B mishap, down from three in FY05. Only two FY06 Class C mishaps and 56 Class E events represented a decrease from eight Class Cs and 66 Class Es in FY05. FY06 was simply an outstanding year for safety in the B-2 community, and was a direct result of leadership's focus and involvement with a comprehensive and effective system safety program.

Class B Mishaps

The one B-2 Class B mishap was propulsion-related. The aircraft was scheduled for two training sorties from the operating base with two separate crews. An Engine Running Crew Change (ERCC) was planned between sorties. The first sortie was 5.4 hours in duration, and included simulated guided weapons delivery, air refueling, two touch-and-go landings, and one full stop landing. All engine indications throughout the flight were normal. The first sortie landed 30 minutes late in order to accommodate a change in air refueling times and receive adequate weapons-delivery training. After the full stop landing, the crew taxied to a hard stand for the planned ERCC.

The second sortie was scheduled for 5.0 hours in duration, including simulated guided weapons delivery, air refueling, and transition. The mission was planned as a two-ship formation "show and go" and, due to the longer than planned first sortie, the formation mission commander decided to launch the number two aircraft to perform local instrument training while waiting for the lead aircraft to become airborne.

During the lead aircraft's subsequent takeoff sequence, all acceleration cues, engine and takeoff performance indications were normal. Passing 70 knots calibrated airspeed, the aircrew simultaneously noticed the master caution light accompanied by number three engine caution and engine vibration indications on the engine multi-display units. The aircrew immediately initiated abort procedures and brought the aircraft to a safe taxi speed to exit the active runway. All engine vibration indications returned to normal, but in an effort to exit the runway, the aircrew increased the throttles on all four engines. At approximately one-half a throttle knob's width of power increase the aircrew heard a loud noise and vibration emitting from what was believed to have been the number three engine. The aircrew initiated engine shutdown procedures IAW T.O. 1B-2A-1CL-1 while coordinating with supervision to return to parking.

Post-flight inspection revealed a liberated fan blade lodged in the bypass section of the number three engine. The fan blade liberation was due to a fatigue crack which propagated until the dovetail shank could no longer restrain the blade. The liberated blade set off a chain reaction that ultimately damaged the fan rotor section and high-pressure compressor components.

General Electric and the system program office have assessed appropriate actions to mitigate the blade fatigue hazard. General Electric has pursued development of an ultrasonic inspection that will be performed on-wing, with the plan to introduce it as a one-time inspection with subsequent intervals to be determined.

Class C and E Mishaps/Events

The two FY06 B-2 Class C mishaps involved a ground taxi wingtip collision with a temporary structure, and a main landing gear cushioning pad dropped object during approach and landing. The wingtip-collision mishap highlighted the necessity for aircrews to remain focused and vigilant during taxi operations, and to develop coordinated communications plans for all assets operating on established taxiways/ramps. 52 of the 56 FY06 Class E events were BASH-related, with the remaining four consisting of two propulsion, one physiological, and one controlled area movement violation event.

FY06 B-52 Safety Review

The B-52 community enjoyed an outstanding year of safety in FY06, with no Class A mishaps and only one Class B mishap, a decrease from two Class As and six Class Bs in FY05. Class C mishaps decreased from 17 to 16, and Class E events decreased from 169 to 152 in FY06. Leadership focused on safety and continued effective reporting, hazard identification, and mitigation resulted in one of the best safety years ever for B-52s.

Class B Mishaps

The one FY06 B-52 Class B mishap was propulsion-related. The sortie was briefed and planned as a scheduled local training mission. The takeoff, flight, landing, and taxi to parking were uneventful, with no abnormal engine indications observed by the aircrew. Post-flight inspection by the maintenance crew chief revealed damage to the number one engine turbine section.

A subsequent borescope of the turbine section revealed major damage to the fourth-stage turbine vanes, a missing third-stage lock ring/air seal spacer and minor damage to the second-stage blades. The engine tail pipe was removed and the turbine exhaust case mount rail for the tail pipe was found cracked, along with damage to the exhaust struts. Inspection of the fourth-stage turbine wheel indicated damage to the turbine wheel and the nozzle vanes. All damage was confined to the engine.

The engine was shipped to depot for analysis and repair. The depot confirmed that the first-stage turbine outer air seal was the initiation point of the turbine damage, and that the air seal failed in multiple circumferential locations due to fatigue. Additional damage to the high-pressure turbine rotor, the low high-pressure turbine rotor, as well as first- second- third- and fourth-stage nozzle vanes was confirmed. The number-five combustion can showed significant evidence that it had shifted after the air seal's failure; the spark igniter was worn on one side, the combustion can nozzles were worn, the combustion can crossover tubes were worn, several cracks were found in the number five combustion can caused by the excessive heat, and a piece was found missing from the number five combustion can nozzle swirl guide. Localized hot spotting in the combustion section, due to the number-five combustion, caused excessive heat. This resulted in premature metal fatigue and failure in the fourth-stage turbine section components. Total damage to the engine exceeded $310,000.

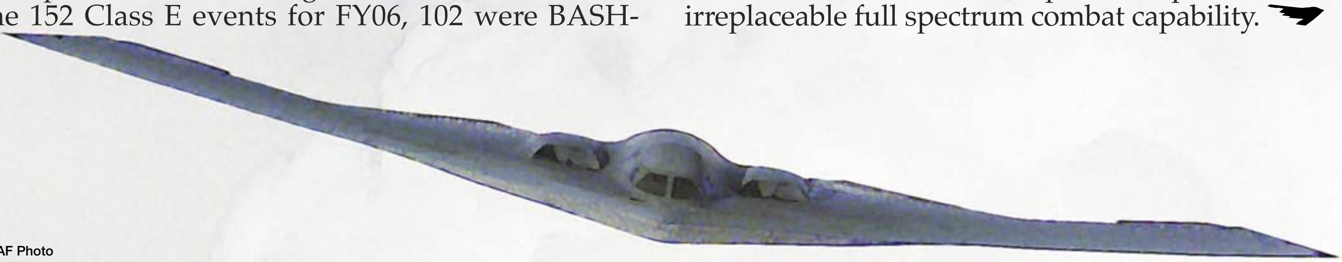
The turbine outer air seal part number has had no known history of this type of failure, but there have been similar isolated failures of older part number air seals. In-place engine inspection procedures were directed during planned phase inspections to detect and prevent additional failures of this type.

Class C and Class E Mishaps/Events

Of the 16 B-52 Class C mishaps in FY06, seven were engine-related due to various factors, all of which have been addressed in ongoing system safety efforts. The remaining Class C mishaps included damage during air refueling, a bird strike damaged radome, a lightning strike damaging the wingtips, and a high speed abort resulting in replacement of all eight wheels and tires. Of the 152 Class E events for FY06, 102 were BASH-related and 34 were propulsion-related. The B-52 community vastly improved over the previous year's safety performance in reducing reportable injuries to flightline personnel and aircraft damage during aircraft ground operations.

Bomber Safety Summary

It is safe to say that the bomber community in FY06 did its fair share in contributing to the best overall aviation safety year in USAF history. Focused leadership at all levels, sound operational risk management, and institutionalized safety practice and culture continued to preserve precious and irreplaceable full spectrum combat capability.



USAF Photo
Photo Illustration by Dan Harman

Note: Statistics include mishap updates that occurred after this article was submitted.

B-1

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	1	5.09	7	35.66	0	0.00	0	0	19,632
5 YR AVG	1.8	7.76	9.6	41.38	0.2	0.86	0.0	0.0	23,202.2
10 YR AVG	1.1	4.65	6.1	25.76	0.3	1.27	0.2	0.4	23,677.3
LIFETIME CY84-FY06	21	4.33	73	15.05	7	1.44	6	11	485,086

B-2

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	1	14.18	0	0.00	0	0	7,050
5 YR AVG	0	0.00	1	20.40	0	0.00	0	0	6,864
10 YR AVG	0	0.00	1	14.07	0	0.00	0	0	5,684
LIFETIME FY90-FY06	0	0.00	8	12.38	0	0.00	0	0	64,595

B-52

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	1	3.95	0	0.00	0	0	25,315
5 YR AVG	0.2	0.75	1.8	6.72	0.0	0.00	0.0	0.0	26,794.2
10 YR AVG	0.1	0.41	2.0	8.15	0.0	0.00	0.0	0.0	24,529.2
LIFETIME CY55-FY06	98	1.28	184	2.40	76	0.99	99	315	7,669,414

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

A-10

LT COL (GAF) JOERGE BEHNKE
HQ AFSC/SEFO
MAJ TOM FERENCZHALMY
HQ AFSC/SEFF

USAF Photo by SSgt Karen Z. Silcott
Photo Illustration by Dan Harman

After reviewing A-10 mishaps and mishap rates for FY06, it is hard to find the right statement to accurately quantify our efforts. We made some progress, but we also had some setbacks. The real question is, "Can we consider FY06 a good year, or should we consider it more along the lines of an average one?"

FY06 was a very good year considering the awesome fact that we didn't have any fatalities or destroyed aircraft. This is undoubtedly the most important aspect of the past year's safety record. Unfortunately, we did have one Class A versus none in FY05. There were six Class Bs versus last FY's five. Yet, the 41 Class Cs we had were a 30 percent decrease from the previous year. So, what is the final score? To count FY06 as a success, we need to consider the Class A and additional Class B to be balanced by the 30 percent fewer Class Cs. But does this really give an accurate perspective of FY06?

Before discussing the Class A and Bs, I'll try to summarize some of the main issues. Examining the individual causes shows that we are still fighting problems with material and maintenance issues. They represent the majority of all mishap causes over the last year. This is evident when noting the increased number of mishaps involving slats and landing gear malfunctions, and it should be of increasing concern. Almost a third of all reportable A-10 mishaps occurred due to problems with these systems. Keeping this in mind, we should always be prepared to confront the unexpected, especially when the "demanding" portion of a long mission is complete. Also, avoid the tendency to "mentally" shutdown as soon as you hit the ground. Be on guard for such incidents, and know your systems and emergency procedures cold. For those of us working the safety desk—encourage reporting of all incidents, monitor incidents for developing trends, and mitigate identified hazards.

This leads me to our sole Class A for FY06.

The aircraft was number four of a four-ship flight lead upgrade sortie. The flight took the runway for a ten-second interval takeoff, completed all checks and engine run-up, and released brakes. Shortly after brake release, a component failed on the right main landing gear, deactivating the weight-on-wheels switch which resulted in loss of right brake pressure. As a result, the aircraft began rolling, pivoted to the left, and departed the runway. The left main landing gear collapsed as the aircraft came to rest just off the runway. The left side of the aircraft impacted the ground damaging the under wing stores and flight control surfaces. The pilot shut down the engines and egressed safely.

Class B Mishaps

The Hog experienced a total of six Class Bs in FY06, one of which was categorized as a Ground Mishap while the other five were engine-related. Two of the five engine-related mishaps were caused by FOD from different sources. Here is a brief summary of each of these mishaps.

- The first Class B occurred during a scheduled single-ship aerial demonstration practice. The majority of the flight was uneventful until the aircraft experienced a compressor stall in the number-two engine while extending the landing gear. Indications included an increase in Interstage Turbine Temperature (ITT) and an RPM rollback below idle thrust. The pilot shut down the engine and landed uneventfully. The compressor stall was due to a mechanical failure in the main fuel control.

- The second Class B was a number-one engine failure during a local training mission. The pilot had retarded the throttle to idle when a malfunction in the main fuel control occurred leading to a compressor stall. The engine was shut down, the appropriate emergency checklists were completed, and the aircraft was safely recovered without further incident.
- The third Class B warrants a bit more discussion. The mishap occurred during the final portion of a six-ship redeployment. The cell was at cruise altitude when the number-four aircraft experienced a compressor stall in the number-two engine. Initially, the mishap appeared to be a fairly straight forward engine compressor stall, likely due to operation in an environment with reduced engine stall margin (black-striped region of engine envelope.) Further investigation revealed several contributing factors and discrepancies, which ultimately led to the pilot becoming spatially disoriented. Fortunately, the pilot was able to recognize the disorientation, and recovered the aircraft from the resulting unusual attitude. He then recognized the compressor stall, shut down the affected engine, and safely recovered the aircraft via a single-engine approach. A note to unit safety officers: this report provides several lessons learned, and is definitely worth briefing at your next safety meeting or prior to a deployment.
- Class B number four occurred during air-to-ground gunnery. The pilot observed a high ITT, shut down the engine and recovered safely via a single-engine approach. This mishap is still under investigation.
- The fifth Class B occurred during engine run-up prior to takeoff. The pilot noticed a higher than normal fan speed indication for the number-one engine that was later accompanied by illumination of the corresponding "engine hot" light. The pilot reduced the throttles to idle, and taxied back to parking. Maintenance inspection of the engine revealed damage to multiple high pressure turbine components. The engine was sent to depot for teardown and analysis.
- The last Class B mishap of FY06 occurred during the second mission following hot-pit refueling. The pilot noticed abnormal fan speed indications during the takeoff roll and continued the takeoff. An In-Flight Emergency (IFE) was declared and the aircraft was safely recovered via a single-engine approach. Investigation revealed a water intrusion plug was ingested by the engine. Unfortunately, this is the third such mishap in the last three years.

Class Cs

In FY05 we had seven Class C mishaps due to injuries incurred during aircraft maintenance operations. Of the 41 Class C mishaps reported this year, we didn't experience a single Class C due to maintenance injuries. So, we've obviously learned a few lessons.

All in all, when we look back at the history of the mighty Hog, FY06 was one of the safest years ever. My hat's off to you! This excellent record took everyone's efforts to achieve, and will continue to require everyone's keen eye and good judgment to uphold. So, don't relax and let your guard down now. Despite some nice equipment upgrades, the Hog isn't getting any younger, and new challenges are likely around the bend. Everybody involved with A-10 operations, whether a pilot or maintainer, needs to understand that continued safe operations with a 28 year-old aircraft requires diligence, foresight and close monitoring to lead-turn developing "cracks" that could lead to big problems. Keep this in mind, and try to look at what you do from a different perspective to find possible improvement areas. Think out of the container, and step back from your normal routines to see if there are things you can do to better mitigate hazards. And don't forget the routine/normally low-threat portions of your missions—we still experience a very large portion of our mishaps during takeoff and landing ops. Forget about your pride—fess up when you screw up, so others can learn from your mistakes. Get back in the books and be ready for whatever Murphy throws at you next. ATTACK!

A-10

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	5	4.40	0	0.00	0	0	113,550
5 YR AVG	1.2	1.03	5.8	4.98	1.4	1.20	0.8	0.8	116,575.0
10 YR AVG	1.6	1.36	5.0	4.24	1.5	1.27	0.7	0.7	117,849.1
LIFETIME CY72-FY05	100	2.24	95	2.13	101	2.26	51	58	4,463,848

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

Strategic Airlifters

LT COL JEFFREY THOMAS
HQ AFSC/SEFF

When reviewing FY06 in the strategic airlift community … to steal directly from Charles Dickens … "It was the best of times, it was the worst of times." The last C-141 retired to the Boneyard in FY06. The C-17 tied its fewest number of Class A mishaps since FY01 and (knock on wood, rub lucky rabbit's foot, etc.) still has not suffered a destroyed aircraft Class A mishap since it became operational 15 years ago. The C-5 community suffered a Class A destroyed aircraft mishap in April at Dover AFB, the first C-5 crash since the August 1990 Class A mishap at Ramstein AB, Germany.

FY06 lookback reveals the airlift community experienced 11 reportable Class A and B mishaps, as compared to 21 in FY05 and 7 in FY04. Let's break it down ….

C-5

The Galaxy community experienced two Class A mishaps (although several mishaps bounced back and forth between the Class A and B range before finally settling into the Class B category), five Class B mishaps and 17 Class C mishaps in FY06.

- Chief headline grabber was the aforementioned Class A mishap that occurred at Dover when a C-5 landed short of the runway during an emergency return, shortly after takeoff with an engine shutdown. Following a normal takeoff and initial climb, the C-5 aircrew observed a number-two engine "Thrust Reverser Not Locked" indication light. They shut down the number-two engine as a precaution and returned to Dover AFB. The Accident Investigation Board (AIB) Report determined that the pilots and flight engineers did not properly configure, maneuver, and power the aircraft during approach and landing. During the return to base the pilots, unnoticed by flight engineers, used the shut-down number-two engine's throttle leaving the fully-operational number-three engine in idle resulting in an inadvertant two-engine approach being flown. This, in concert with the selection of 100 percent flaps and pilot's descent well below a normal guidepath, put the aircraft in a thrust deficient situation from which it could not reach the runway. All 17 people on board the C-5 survived the crash, but three flight deck crewmembers were seriously injured when the aircraft stalled and crashed in a nose high, tail first attitude into a field about a mile short of the runway. The other passengers and crewmembers sustained minor injuries and were treated and released from local hospitals.
- The second Class A mishap involved a brake fire following a night landing. According to the AIB report the mishap crew flew a partial flap (40 percent) visual approach with the mishap aircraft well above landing weight. Touchdown occurred approximately 2000 feet down the 9600 foot long runway. Due to a delay in deploying spoilers and thrust reversers the mishap pilot was forced to apply moderate to heavy braking to bring the

USAF Photo by SSgt John McDowell
Photo Illustration by Dan Harman

heavyweight aircraft to a safe taxi speed within the remaining runway. Once in parking, the deplaning flight engineer discovered a brake fire on the number-two main landing gear which was quickly extinguished. The report found that the pilot's decision to use partial flaps coupled with a malfunction in the wheel spin-up detection system (which delayed spoiler deployment) caused the brake fire incident.

There were five Class B mishaps in the Galaxy community in FY06, up from two in FY05 and one in FY04. No clear trend emerged while looking at these mishaps. One involved a compressor stall during a maintenance run, a ram air turbine departing an aircraft in flight, a hard landing during an off-station training sortie, an aft main landing gear failure during taxi and engine damage discovered during a home station check.

While no trends existed with regards to C-5 Class B mishaps, Class C mishaps show a definite trend … engines! Seventeen Class C mishaps where recorded. Ten of which involved engine-related issues, seven of those which involved an engine flameout, fire or precautionary shutdown in flight. Word to the wise; be proficient at three-engine approaches and landings, and the accompanying procedures, particularly with regards to heavyweight operations. If you need more encouragement, go back and review the first C-5 Class A mishap we discussed above.

C-17

The Globemaster II, like the C-5, experienced two Class A mishaps in FY06, a marked decrease from six in FY05 and three in FY04. One C-17 Class A mishap involved an engine fire that occurred in flight following a catastrophic internal failure during a local training sortie. The crew properly handled the emergency, and got the aircraft safely back on the ground. The second, upgraded from a Class B mishap, also involved an in-flight engine shutdown and uneventful (except for the shutdown engine) recovery in the AOR. Again, as noted above with C-5 incidents, proficiency at three engine approaches and landings, and the accompanying procedures, could prove beneficial if a real world engine shutdown ever happens to you. Yes, I know, these type events only happen to the "other guy." But remember you are the "other guy" to everybody else.

In the strat airlift community, the award for the biggest decrease in the overall number of mishaps goes to the C-17 for Class B incidents; down to two for FY06 from nine in FY05. Last year's *Flying Safety Magazine* mentioned the primary causes as material failures, an issue that didn't seem to have an influence on the FY06 C-17 Class B mishaps. The first involved a KC-10/C-17 air refueling in which nozzle binding was experienced. The second Class B was a bird strike on departure from an overseas location which resulted in hot brakes and several deflated tires when the mishap aircraft returned to base.

Unlike the C-5 Class C trend of engine-related issues, no clear trend exists in the C-17 community. The C-17 fleet experienced 55 Class C mishaps in FY06, as compared to 50 in FY05 and 38 in FY04. Just over a third of FY06's Class C mishaps involved damage found to Thrust Reversers (TR), a significant increase over FY05 and FY04. Boeing and the Air Force are currently addressing the TR problem. 11 Class C mishaps involved bird strikes in various phases of flight. Approximately half those bird strikes resulted in engine damage. Remember what we mentioned above about proficiency and three engine procedures?

C-141

As mentioned before, we bid a fond adieu to the venerable C-141, after 43 years of service, with the placement of the Hanoi Taxi into the Air Force Museum in May 06. The Starlifter accumulated over 10 million hours of flying time during its lifetime and ended up with a Class A mishap rate of 0.32, admirable for any airframe. As we look back on the venerable C-141, we see some interesting safety statistics courtesy of http://c141heaven.com. These statistics still hold lessons for those who fly current strat airlifters.

The most common human factors mishap in the C-141 was Controlled Flight into Terrain (CFIT). 29 percent of all hull-loss and 45 percent of the human factors-related mishaps were due to CFIT. The Air Force lost one C-141 per year, three years in a row (1973-75) due to CFIT mishaps. With the introduction of a Ground Proximity Warning System (GPWS), the rate of CFIT accidents was reduced dramatically. In the two CFIT mishaps since GPWS, the GPWS warnings were ignored or responded to improperly.

Nearly 50 percent of the mishaps occurred at night. Instrument Meteorological Conditions (IMC) was a factor in almost half of the operational mishaps of the C-141.

Fatigue is a constant hazard of the strategic airlift mission. Long duty days and multiple time zones are standard experiences for airlift crews. In almost half of the aircrew human factors mishaps, fatigue was a contributor to the mishap.

C-5

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	2	3.71	3	5.57	1	1.86	0	0	53,855
5 YR AVG	1.2	1.54	2.8	3.58	0.2	0.26	0.0	0.0	78,119.6
10 YR AVG	0.8	1.17	2.0	2.92	0.1	0.15	0.0	0.0	68,568.7
LIFETIME CY68-FY06	23	1.01	56	2.46	5	0.22	5	168	2,279,772

C-17

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	2	1.26	1	0.63	0	0.00	0	0	158,855
5 YR AVG	2.8	1.89	6.0	4.04	0.0	0.00	0.0	0.0	148,523.8
10 YR AVG	1.6	1.59	3.7	3.67	0.0	0.00	0.0	0.0	100,790.0
LIFETIME CY91-FY06	17	1.62	38	3.63	0	0.00	0	0	1,048,169

C-141

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	0	0.00	0	0.00	0	0	464
5 YR AVG	0.0	0.00	0.6	2.29	0.0	0.00	0.0	0.0	26,220.4
10 YR AVG	0.2	0.36	1.3	2.32	0.1	0.18	0.3	0.9	56,033.4
LIFETIME CY64-FY06	34	0.32	42	0.39	15	0.14	35	161	10,641,969

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

USAF Photo by Danny Meyer
Photo Illustration by Dan Harman

Call for Articles and Imagery

What's your story? Share it with us that we may help others by helping you tell your story better. Save lives and protect assets with your tips, techniques, tools and "There I was," tales.

Groundcrews, air traffic controllers, aircrews, maintainers–any unclassified subject relating to USAF flight safety is welcome.

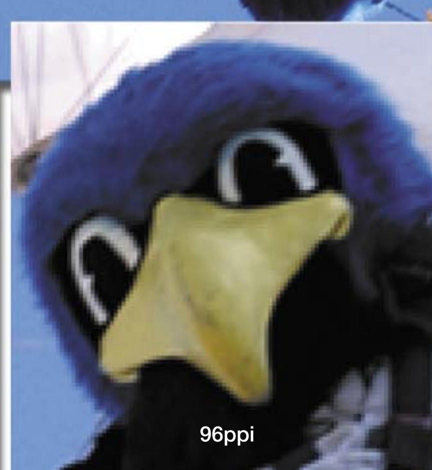
Following is information on imagery requirements for print to avoid the problems that arise from trying to use the low-resolution images associated with the Web or PowerPoint®.

Imagery

This preferred image is printed actual size. It is 5"x 7", 300 pixels per inch (ppi) and approximately 2.5Mb (from 9Mb) in size when compressed to JPEG (Joint Photographic Expert Group) format.

This is the same image reduced to 96ppi, (typical resolution used for the Web or PowerPoint®) to illustrate how it appears in the 300ppi resolution of print. It now has a file size of 945Kb and is unusable for print unless used at this size.

Higher resolution images such as an 8"x10", 300ppi JPEG approximately 4.5Mb (from 20Mb) are really prized, but much can be done with a 5"x7" image as a minimum.



These two images are enlargements of the same area revealing what happens when the low-resolution image's available data is enlarged to the the size of the high-resolution image. Scaling degrades the available data subsequently blurring the image.

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C-130

USAF Photo by SSgt Jeromy K. Cross
Photo Illustration by Dan Harman

MAJOR ERIC DOPSLAF
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Introduction

The USAF as a whole had an "Outstanding" year, one of the "Best Seen to Date" and the C-130 had a year that ran true with the Air Force as a whole, incurring a Class A rate of 0.00 and a Class B rate of 3.6 per 100,000 hours. The most significant improvements over FY05 were in the areas of destroyed aircraft and aircrew fatalities, with no occurrences of either. When comparing the numbers against last year our performance was excellent, but when we look at our rates over the past five to ten years we can only consider ourselves slightly above average. The breakdown of total rate producing mishaps for FY06 is: 0 Class A, 9 Class B, 96 Class C and 2414 Class E reported mishaps (reporting against approximately 280,000 hours flown).

The only Class A incident involved an E-model deployed to the AOR and was categorized as an aviation ground mishap, thus incurring a non-rate-producing classification. The Mishap Aircraft (MA) had a brake assembly fail upon landing, resulting in a hot brake condition. Of the 13 Class B mishaps (rate and non-rate) 85 percent (11) were associated with either power-plant malfunctions or bird strikes; these two areas also made up over 73 percent (71) of the reportable Class Cs from this year. Foreign Object Damage (FOD) and wildlife strikes still remain the most significant individual factors in Class B and C incidents.

The total of 2400+ Class E mishaps is noteworthy on many levels, reflecting significant improvement in reporting discipline and the quality of training. The most astonishing fact is that 58 percent (1410) of the 2414 incidents were wildlife strikes, with propulsion coming in second at 30 percent (734). Again, these two areas are the most influential factors in the Herc community, making up 88 percent of the Class E and 73 percent of Class B/C, with an overall total percentage of 86 percent. Of the remaining classifications, a few trend areas still continue to be noteworthy and those are: smoke and fumes (52), physiological (30) and Hazardous Air Traffic Reports (HATRs) (72). The above numbers are a testament to how we have improved in our reporting practices however, there's still room for improvement. This will be accomplished through our ongoing effort to ensure we have an equally representative percentage of reporting coming from all components.

Review Of Class A Incident

The MA made a tactical VFR arrival using NVGs into an austere airfield. The aircrew did not realize that one of the brake assemblies had failed sometime prior to the landing rollout and was disintegrating upon touchdown. During rollout and the subsequent taxi to parking, numerous issues were working against the MA crew, the most significant being that only three of the brakes were working. The factors contributing to the hot-brake condition developing in the left wheel area included a failed assembly, long taxi distance, engines unable to be down sped and visual illusions associated with NVG taxi speeds. The temperature was so intense that it melted the piston seals allowing hydraulic fluid to leak onto the heated area, resulting in a fire. The six-person crew and 56 passengers successfully evacuated the aircraft without injuries. The fire department responded promptly and put out the fire in minimal time, but not before it burned through the left wheel well and up the side of the MA. The destruction caused by the fire significantly damaged the brakes, left-main landing gear, hydraulic lines, tires and wheel well vertical beams to the tune of approximately 5.9 million dollars.

This mishap, in conjunction with numerous Class C incidents dealing with hot brakes, anti-skid or blown tires generated an FCIF from AMC/A37. The FCIF reiterated the need to be attentive to common operational areas that could lead to a hot brake condition. Those areas include: hot weather, gross weights above 115,000 pounds, heavy-weight assault landings, NVG operations, extremely long taxi distances and multiple partial brake applications. In addition to the FCIF, the SPO (in partnership with the brake system engineers at Hill AFB) is conducting an in-depth analysis of C-130J brake assemblies. They are evaluating the effects of newer brake components while looking into the possibility of devising taxi-distance charts based on gross weight. Aircrews should place special emphasis on the requirements in the flight manual and the AMC message regarding the use of wheel brakes. Bottom line; treat them with the respect they deserve!

Review Of Class B Incidents

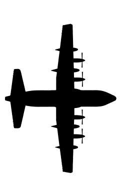
The most significant and substantial areas to note about the Class B arena this year are power plant (7) and wildlife strikes (4). These two areas account for 11 of the 13 mishaps, for a total of 85 percent. Further analysis revealed that of the seven engine-related incidents, four were contained FOD, one Reduction Gear Box (RGB) and two remain undetermined. Total dollar value to date for all Class Bs is over four million dollars and will increase significantly once all engine-damage estimates are completed and entered into the system.

One incident that is of value to discuss: the lightning strike that occurred to an aircraft en route to home station, after conducting operations at one of their local operating fields. The MA was struck by lightning at 16,000 feet MSL with an outside air temperature of -1C, and convective activity in the area. The crew did a visual inspection, observed no apparent damage to the aircraft or equipment, and opted to return to base. En route, the navigator noticed the radar was not working properly and figured the RT was going bad due to other factors. However during the post-flight inspection, maintenance discovered damage to an aileron indicating a lightning exit point. Final damage total was approximately $400,000 with the radar, radome and the infrared detection system damaged. We all check the weather when we go off station, and must remember not to exclude weather at the local airfields where we train. If in doubt turn it about.

Review Of Class C Incidents

The Class C mishap summary reads almost like the Class B summary with 73 percent of the incidents coming from two categories: power plant (38) and wildlife strikes (18). There are other areas showing trends that should be noted, these include: gear, brakes, anti-skid and lightning.

In conclusion: take care of the engines, brakes and keep your eyes outside. Just because you're flying in the AOR, that is not an excuse to use max continuous thrust. Only use it when you need it. The time you save on the mission only adds up to a few minutes, but the cost to the engine will be millions. With the high ops tempo and the demanding missions, take care of the details as it is the small things that usually add up to a big problem. Remember good CRM, and if it seems stupid it probably is--break the error chain. Fly Safe in '07.

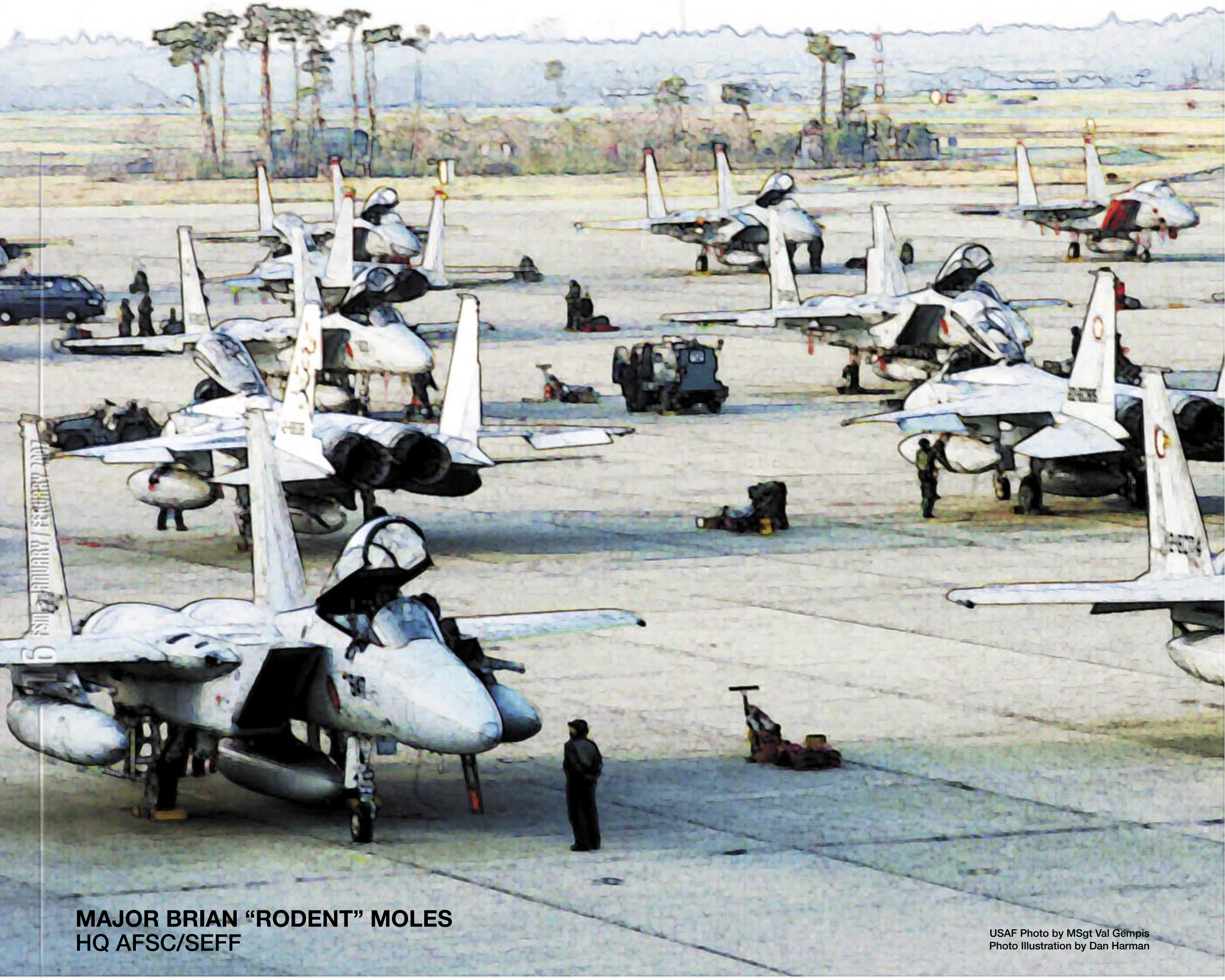


C-130

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	9	3.21	0	0.00	0	0	280,668
5 YR AVG	1.2	0.39	9.2	2.95	1.0	0.32	0.8	4.4	311,577.4
10 YR AVG	1.1	0.37	7.0	2.37	0.7	0.24	0.6	3.8	295,298.3
LIFETIME CY55-FY06	151	0.88	211	1.24	88	0.52	138	638	17,079,666

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

F-15



MAJOR BRIAN “RODENT” MOLES
HQ AFSC/SEFF

USAF Photo by MSgt Val Gempis
Photo Illustration by Dan Harman

Many of you may already know that FY06 was a historic USAF safety year. The overall Class A rate for the year was 0.90 (per 100,000 flying hours), a significant decrease from the 1.49 rate logged in FY05. Although the fighter/attack rate actually increased over last year (from 1.45 to 1.94), the mighty Eagle more than held its own among its fighter/attack brethren. The Eagle enjoyed one of its safest years ever, coming in with a Class A rate of 0.59 (as compared to 1.77 in FY 05). These impressive numbers are not due to luck. It takes hard work and discipline to make that much improvement. The Eagle experienced one Class A rate-producing mishap for the year and thankfully, zero fatalities. Although this continues a positive trend for the last five years, it doesn’t mean we can’t learn from the past and continue improving.

Overall, the F-15 experienced two Class A mishaps for the year (one rate-producing). Both involved engines, but both were decidedly different in nature. One happened on the ground, and the other airborne resulting in loss of aircraft and a reaffirmation of the ACES II ejection seat. Let’s take a closer look at the Class A mishaps from last year.

Class A Mishaps

Engine failure resulting in aircraft loss. (The following is taken from the Accident Investigation Board [AIB] Report). 31 minutes after takeoff, the pilot heard a loud bang and felt the aircraft shudder. The pilot received multiple right-engine overheat and fire warnings, applied necessary emergency procedures, then shut down the right engine. After engine shutdown, the pilot began experiencing right rolling tendencies. Eventually the pilot was unable to counter this right roll and made the appropriate decision to eject. The pilot was successfully recovered and suffered only minor injuries. Although the initial cause of the engine failure is undetermined, parts from the failed engine likely pierced the right engine case eventually damaging critical flight control systems leading to the unstoppable right roll.

Engine-ingested FOD. (From Preliminary Report). Following an uneventful local sortie, the aircraft returned to parking where personnel were working a minor aircraft issue. A gear pin was ingested in the number-one engine prior to shutdown.

Class B Mishaps

There were 12 Class B mishaps in FY06, three more than FY05. This continues an increasing trend of Class B F-15 mishaps over the last five years. Nearly half of the FY06 Class B mishaps were engine-related. These engine-related mishaps include two for domestic parts damage (i.e., bolts liberating), a variable ramp separating and being ingested by an engine inflight, a stall/stag with core damage, and a bearing failure. It is no surprise that any of these push dollar amounts into the Class B range.

As for the other Class B mishaps, there is once again nothing new under the sun. There were two incidents of canopy loss, two incidents of gear failure on landing (at least one due to fatigue), and two due to weather (one lightning strike and one hail damage). Finally, one incident involved a Jet Fuel Starter (JFS) malfunction which caused damage to the JFS and Central Gear Box (CGB). As you can surmise, while some of these can be attributed to parts failing, others involve stick-actuators and wrench-turners. Once again there's nothing new here, but certainly things we can learn from.

Other Mishaps And Events

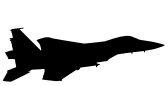
Of the nearly 200 other mishaps and events reported last year, several themes stand out. Birds continue to wage their war of attrition on the fleet. Over 130 strikes were reported (five in the Class C range.) This amount hasn't drastically changed over the last few years. Although our kill rate is superior, these beak to beak encounters are costing the AF a hefty sum.

The fleet continues to show signs of age as pieces keep falling off airplanes, parts continue to fail within them, and jets continue to depart from controlled flight. Not all of these can be attributed to age and wear however. Even new jets will have issues if they're not maintained or flown properly.

Other consistent contributors include smoke and fumes events and display problems. Hopefully, current hardware upgrades can help reduce these numbers in the near future. There were a few notable improvements over the previous year. FOD incidents declined (although one led to the previously mentioned Class A). Also, ground mishaps involving our maintainers decreased significantly. These improvements undoubtedly speak to the great efforts of our maintainers and their supervisors.

Lessons Learned

FY06 was an historic year in AF aviation safety, and Eagle aircrew and maintainers can certainly hold their collective craniums high contributing to this achievement. The steady decline in Eagle Class A mishap rates over the past few years are a testament to the discipline you all continue to display. Before we wear out our hands patting ourselves on the back though, we need to keep in mind that nearly all of the mishaps we experienced were preventable at some stage. Some of these may be out of your hands, but many are directly in them. We should all be working toward the day that words such as "BASH," "FOD" and "Departure" surprise us when attached to reports, rather than are dismissed as commonplace. Remember, "Murphy" is alive and well and the "bus load of nuns" is approaching the active. Keep up the outstanding work, and keep the bad guys on the run.



F-15

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	1	0.59	12	7.11	1	0.59	0	0	168,854
5 YR AVG	3.2	1.75	9.0	4.91	1.8	0.98	0.2	0.2	183,213.2
10 YR AVG	3.6	1.95	10.4	5.63	2.2	1.19	0.4	0.5	184,853.1
LIFETIME CY72-FY06	127	2.38	239	4.48	109	2.04	38	45	5,336,084

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

F-16

MAJOR (CAF) TERRY HOFFART
HQ AFSC/SEFF

The F-16 did not have a good year from the safety perspective in FY06. There were a total of ten Class A mishaps reported in FY06 with a Class A mishap rate of 3.12 per 100,000 flight hours. Both these numbers exceeded the ten-year average, which is never a good indicator of the statistical direction we would like to be moving. While we lost five valuable combat assets, we were again fortunate last year not to lose any aviators. However, we had one Class A flight-related mishap in which, sadly, we lost a maintainer during a physiological incident on an incentive ride. Let's take a closer look at last year's mishaps and see what we can learn.

Class A Mishaps

Of the ten FY06 Class A mishaps, four were due to aircraft loss of control in the air and on the ground, three were due to collisions with other objects, two were due to engine problems, and one was due to a physiological event:

- F-16C tire failure. (Taken from the Accident Investigation Board [AIB] Report). An F-16 departed the runway surface on landing following failure of the left main landing gear (MLG) tire and subsequent collapse of the left MLG. The aircraft came to rest approximately 100 feet off the runway and the pilot egressed without injury.

The mishap was caused by failure of the left MLG tire. Inadequate maintenance documentation and procedures were contributing factors to the mishap. Maintenance personnel's failure to accurately track the number of landings resulted in the MLG

USAF Photo by SSgt Michelle Michaud
Photo Illustration by Dan Harman

tires being used for landings that were in excess of the proscribed maximum (22 landings on tires restricted to 20 landings). Several other factors also existed that may have contributed to the tire failure: heavier than normal aircraft configurations, deteriorating runway conditions, on-going FOD problems and lengthy taxi distances.

• F-16 midair collision. (Taken from the AIB Report). An F-16C was struck by a KC-10A Air-to-Air Refueling (AAR) Boom while conducting AAR. Damage to the KC-10 was minor while the F-16 received structural damage to the top right side fuselage. The F-16 jettisoned his external fuel tanks and recovered safely to home station.

The mishap was caused by the KC-10 boom operator's abrupt flight control stick inputs in reaction to the F-16's two to four knot closure rate and elevated position in the AAR envelope. To avoid striking the F-16 vertical stabilizer the KC-10 boom operator jerked back on the boom flight control stick causing the boom to move up rapidly towards the underside of the KC-10. To avoid striking the underside of the KC-10 the KC-10 boom operator then pushed forward on the boom flight control stick causing the boom to swing down at a high rate of speed striking the F-16.

• F-16 loss of control on landing. The pilot flew an instrument approach for a full-stop landing. Initial touchdown was uneventful but upon slowing, the aircraft began to veer to the right. The aircraft departed the runway approximately 5,000 feet down the runway. The pilot accomplished emergency procedures and safely egressed the aircraft after it came to a complete stop. Significant damage was done to the right main gear, the ALQ-184 ECM pod and the 341 bulkhead.

• F-16 loss of control. (Taken from the AIB Report). An F-16 departed controlled flight during a Basic Fighter Maneuvering (BFM) mission. The pilot was unable to regain control of the aircraft and safely ejected.

The mishap was caused by a chain of failures in the aircraft Flight Control System (FLCS). During the fifth BFM engagement, the aircraft experienced an Integrated Servo Actuator All Fail (ISA ALL FAIL). The FLCS was not reset. During the fifth and sixth BFM engagement, the aircraft experienced a Branch D FLCS COMPUTER FAIL and a FLCS Angle of Sideslip Fail (FLCS AOS FAIL). During the seventh BFM engagement, when the aircraft was in a low-speed regime, the aircraft experienced a Branch C FLCS COMPUTER FAIL, which when combined with the previous failures forced the aircraft into a Dual FLCS Branch Failure situation. The combination of the ISA ALL FAIL and the Dual FLCS Branch Failure caused the loss of any input to the horizontal tails. Without any pitch input, and with the aircraft already at slow speed, the aircraft went into a deep stall and out of control. Although the chain of FLCS events caused the aircraft to go out of control, the pilot had at least three opportunities to recognize and correct the FLCS malfunction, keeping the aircraft from getting to an out of control situation. However, the F-16CG Dash-1 did not give pilots the information or guidance necessary to handle the combination of this mishap chain of events.

• F-16C engine failure. (Taken from the AIB Report). An F-16 was participating in a training mission when it experienced a compressor stall. Although the stall initially cleared, and the pilot jettisoned his stores to minimize weight and drag, the engine was unable to produce the thrust required to maintain level flight. The pilot ejected safely and the aircraft was destroyed on impact.

The mishap was caused by the failure of the number-four bearing assembly within the General Electric F110-GE-100 engine. The failure caused turbine blade-to-shroud interference, as evidenced by severe compressor blade tip rub and grooving of the honeycomb seals. This resulted in engine degradation and reduced efficiency to a point insufficient for providing the thrust required to maintain level flight. The distance to the nearest airfield was beyond the glide capability of the aircraft.

• F-16C loss of control. (Taken from the AIB Report). While performing BFM the pilot ejected. Ejection was initiated at 6,720 feet Mean Sea Level (MSL), approximately 80 degrees nose low, 656 Knots Calibrated Airspeed (KCAS) with a descent rate of 1100 feet per second. The pilot suffered major injuries during the high speed ejection.

The mishap was caused by the pilot suffering G-induced Loss of Consciousness (G-LOC) that resulted in what the pilot correctly assessed as an unrecoverable aircraft altitude (based on his diminished cognitive capability.) An extended break from flying to attend a formal military school, physical fatigue from flying five high-G sorties in three days, and the mental stressors associated with beginning the Instructor Pilot Upgrade (IPUG) were contributing factors to the mishap.

• F-16C engine failure. (Taken from the AIB Report). Shortly after initial takeoff from a two-ship, afterburner formation takeoff, the pilot heard a loud bang and felt the aircraft shudder as he reduced power to maintain formation position. The instructor pilot in the lead aircraft reported a fire at the back of the mishap aircraft, and directed the student pilot to return to home station. The pilot attempted to regain control of the engine, was not successful, and safely ejected.

The mishap was caused by a malfunction in the Rear Compressor Variable Vane (RCVV) system of the engine that caused the non-recoverable engine stagnation and resulting crash. Although the evidence was not conclusive, the failure determination was based upon available data and expert opinion.

• F-16C bird strike. On initial takeoff, an F-16CJ struck a large bird shortly after gear retraction while below a scattered deck of clouds. The pilot felt an impact, climbed through the weather to high key over the airfield, and contacted the Supervisor of Flying (SOF). The pilot felt slight vibrations, and noted an engine stall Maintenance Fault List (MFL) code. After reviewing checklists and conferring with the SOF, the pilot assessed that a bird had been ingested into the engine. The pilot determined the engine was producing normal thrust, remained at high key to reduce gross weight and elected to retain external stores. Approximately 50 minutes after takeoff, the pilot executed a Simulated Flame Out (SFO) pattern to a safe landing. Upon touchdown, the pilot observed the Anti-Skid caution light. The pilot applied the wheel brakes, and the aircraft transitioned to pulsating brakes. The pilot lowered the hook, and successfully engaged the departure end cable at low speed. Emergency crews responded, pinned the landing gear and emergency power unit, and the pilot shut down the aircraft on the runway.

• F-16D Physiological Fatality. (Taken from the AIB Report). During an orientation flight the passenger in the back seat became incapacitated, and the flight was aborted and returned to base. The passenger was unconscious upon landing. He was transported to a local hospital where he subsequently died of medical complications.

The mishap was caused by a lack of oxygen to the passenger during the climb-out when the passenger inadvertently stopped his oxygen flow to his mask regulator. Almost immediately after takeoff the passenger began to breathe rapidly causing the onset of hypoxia. Head-Up-Display (HUD) transcripts revealed the passenger was uncomfortable with the amount of air he was receiving. At some point, the passenger attempted to "gang load" his oxygen regulator as he was taught in life support training. By gang loading his regulator he would have to move the emergency lever to "EMERG" position causing pressurized air to enter his mask. He would also move the diluter switch to "100 percent" which changes the oxygen flow to 100 percent, vice a mixture of ambient air and oxygen. With a sense of urgency, the passenger reached down and did the opposite of a gang load to relieve the situation (by turning the EMERG switch to NORM and the diluter switch from 100 percent to NORM.) In addition, the passenger inadvertently turned his regulator ON/OFF switch to the "OFF" position at the same time, preventing any oxygen or air mixture to move through the mask. Hypoxic, the passenger was unable to turn the regulator back on or drop his mask. There were three factors that significantly contributed to the mishap: communication difficulties between front and rear cockpits; hyperventilation leading to hypoxia; and regulator design and rear cockpit placement.

- F-16C ground strike. While flying a visual pattern to the runway the aircraft impacted the far field monitor antenna used for the Category II instrument landing system. The aircraft sustained extensive damage to the left main landing gear as a result of the collision. The outcome was a landing gear configuration not considered safe for landing, and a decision was made to proceed to the controlled bailout area for a controlled ejection.

Class B Mishaps

There were also four Class B mishaps in FY06, which was in-line with the ten year average. Of the four mishaps reported, two were engine-related, one was a hard landing, and one was a landing gear collapse.

One of the engine-related mishaps was due to a liberated fourth-stage blade, while the second involved an undetermined fire in the afterburner section of the engine that led to a jettison of external stores after takeoff.

Of the two Class B mishaps that occurred on landing, one was a gear collapse that resulted from a bolt missing from the right main landing gear over center lock actuator while the other involved a hard landing on a night recovery after a Power Takeoff (PTO) shaft failure and resulting loss of the HUD flight data.

Class C Mishaps

There were also 81 Class C mishaps reported in FY06, which was also in-line with last year's totals. The biggest trend noted was landing gear and tire-related mishaps (23 total). These mishaps included blown tires due to pilot error and system failures, hot brakes and brake fires. Two objects attempting to occupy the same space were the second most prevalent class of mishaps, as there were nine Class C bird strikes reported, along with three aircraft damaged during AAR.

Lessons Learned

Of the 89 Class A to C mishaps and over 400 Class E events recorded, there are a couple of themes that are evident and worthy of discussion. I've already touched on the landing gear and tire events. While the jet can be manhandled in the air, it needs to be treated a little more cautiously on the ground. Remember, that the mission is not over until the jet is safely 'back' in the chocks. Pilots always need to have a game plan in mind every time we take off or land, expect the unexpected.

Our feathered friends continue to try to attain air superiority, with over 300 attacks recorded on the nimble Viper. Even though the Falcon maintained air dominance, the AF still had to put up the cash to repair the results of these unprovoked attacks. We always need to be aware of the fact that a bird strike can rapidly turn from a non-event into a Class A mishap when you only have one source of thrust available to keep you airborne!

While the incidence of F-16 departures from controlled flight remained in-line with previous years reporting, the law of averages finally caught up with us as we lost two valuable aircraft due to in-flight loss of control Aircrew must remain cognizant of their operating envelopes, their aircraft configuration, and their emergency procedures. You can also not afford to ignore flight control cautions in an electric jet. The Viper 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.

As I stated above, FY06 was not a good year for the Viper Class A Mishap rate. While I think the message on safely accomplishing the AF mission is being made at all levels, this year's increase in mishaps continue to serve as reminders of hazards established and identified in the past. In following the words of my predecessor, 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	
FY06	9	2.74	4	1.22	5	1.52	0	0	327,979
5 YR AVG	6.8	1.98	4.4	1.28	5.0	1.45	1.0	1.0	343,935.8
10 YR AVG	9.9	2.85	3.8	1.09	8.6	2.47	1.8	2.2	347,963.7
LIFETIME CY75-FY06	321	3.83	69	0.82	297	3.55	77	115	8,370,928

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

F-22

MAJOR BRIAN "RODENT" MOLES
HQ AFSC/SEFF

As the Raptor begins what will undoubtedly be a long and illustrious career, it is never too early to start learning from its past. During the same period the F-22 became operational, the USAF was experiencing its safest year ever in terms of aviation safety, specifically Class A mishap rates. Let's hope this bodes well for the future of this mighty airframe. For comparison, the USAF as a whole decreased its Class A mishap rate considerably from 1.49 (per 100,000 flight hours) in FY05 to 0.90 in FY06. As impressive as this was, the fighter/ attack portion of these totals showed an increase from 1.45 to 1.94 during the same time period. Unfortunately, the Raptor contributed slightly to this increase with a 11.09 Class A mishap rate for the year. This number may seem "eye-popping" in direct comparison, but must be weighed against the smaller number of hours flown as compared to the rest of the fleet (and was half the 24.89 rate experienced in FY05). In reality, the Raptor experienced only one rate-producing Class A (flight-related). Also, with any newer airframe, broken parts will likely drive costs higher in the initial stages of the program. Still, we must start building our lessons learned database to ensure a healthy program life.

As mentioned before, the F-22 experienced one Class A in-flight, with an additional Class A mishap during ground ops. Thankfully, nobody was injured and no jets were lost. Let's take a closer look at these Class A mishaps.

During ground preflight operations, a nose gear pin was ingested by the right engine. Engine damage was significant enough to elevate the mishap into the Class A range.

An F-22 pilot experienced gear problems during a training sortie. The pilot eventually set up for a planned approach-end arrestment. Upon touchdown, the left main landing gear began collapsing. The aircraft successfully engaged the barrier and came to a stop on the runway. The aircraft experienced significant airframe damage and the pilot successfully ground egressed.

Class B Mishaps

There were four total F-22 Class B mishaps in FY06. Of these, two were rate-producing flight mishaps. One rate-producer involved engine FOD damage from an unknown source discovered post flight. The other was a bird strike during pattern work causing extensive engine damage. Of the two non-rate-producing Class Bs, one was an AMAD overheat due to over servicing, and the other was an inadvertent nose gear collapse after landing (during shutdown).

USAF Photo by TSgt Ben Bloker
Photo Illustration by Dan Harman

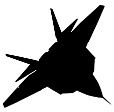
Other Mishaps And Events

Of the over 20 other mishaps and events, a couple of trends stick out. As learned by many other airframes, things that fly cannot occupy the same piece of sky at the same time without bad things happening. While you're doing a great job of not hitting each other, be aware that birds are not so enamored of your capabilities and keep setting up ambush CAPs when you least expect them. There were nine reported bird strikes for the year, a number that will surely go higher as flight hours increase.

A few systems seem to be experiencing more growing pains than the rest. Such systems as the Air Recharge Compressor (ARC), the aforementioned AMAD and the Turbine Power Module (TPM) have contributed more reportable events than others. The good news is that many of these occurred on the ground and were easily controlled.

Lessons Learned

As with any new airframe, the Raptor will go through a period of growing pains. The discipline of F-22 pilots and maintainers is the best way to mitigate these risks. The more the community learns from these early life mishaps and events, the safer the future will be. Nearly every mishap is preventable at some point in the food chain. Continue to maintain the focus, and don't forget to keep an eye on each other. Keep up the great work, and happy hunting.



F-22

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	1	11.09	2	22.19	0	0.00	0	0	9,012
5 YR AVG	0.6	18.30	1.4	42.71	0.2	6.10	0	0	3,278
10 YR AVG	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LIFETIME CY02-FY06	3	18.30	7	42.71	1	6.10	0	0	16,390

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

Tankers

LT COL JEFFERY SMITH
HQ AFSC/SEFF

Departing from past end-of-year articles for the tanker, I do not provide a play by play of the different mishaps. Hopefully, your unit safety officers are providing you with the specifics on individual occurrences that warrant a detailed discussion. If you're not getting regular updates from local safety channels, insist on it. The primary focus of this article is to highlight a disturbing trend in Air Refueling (A/R) mishaps. Fortunately, despite multiple instances (in both airframes) of what could have easily been catastrophes, there was no loss of aircraft or loss of life. I ask each of you to consider what can be done better to reduce the number of mishaps in the following year. Specifically, the lessons learned apply across the tanker board.

KC-10

KC-10s had two Class A (FY05@1), 2 Class B (FY05@3) and 16 Class C (FY05@6) mishaps in FY06. Additionally, there were 38 (FY05@11) Class E events reported. A notable increase in the number of drogue mishaps drove both Class C and E mishaps to more than three times the '05 number. While there were a number of drogue retraction failures, the majority of drogue mishaps were due to reel response speed reduction test failures.

As is the case with the KC-135, A/R mishaps merit the most discussion and all of the A/R elements discussed below in the KC-135 section apply equally to the KC-10. One Class A, two Class B and one Class C mishaps were A/R related*. And, while this may seem small compared to the KC-135, by comparison it is significant as there were no A/R related Class A, B, or C mishaps last year. Read on to the A/R section below for more.

KC-135

KC-135s had zero Class A (FY05@0), 15 Class B (FY05@10) and 68 Class C (FY05@43) mishaps in FY06. Additionally, there were 119 (FY05@119) Class E events reported. There were no clear trends in reported mishaps with the exception of engine, incidents and A/R as discussed below. While 25 of the 119 Class E events were smoke/fume events there was no consistent component failure other than seven of those relating to various forms of ACM failure.

Nine of the 15 Class B mishaps were engine-related. The R model fleet continued to experience engine failures associated with both METCO de-lamination and bearing deficiencies, while engine mishaps in the E model fleet were primarily due to FOD. The R models can expect continued failures as the engines age with a limited opportunity for preventive maintenance replacement of the known failure components. If past statistics bear fruit, future engine mishaps will continue but will be contained. There has not been a single engine mishap associated with METCO de-lamination or bearing failure that has resulted in an uncontained failure on any of the CFM56 civilian or military variants.

USAF Photo SrA Joshua Strang
Photo Illustration by Dan Harman

Air Refueling

Knowing full well the hate mail will probably flow from what I am about to say, it needs to be said—to both pilots and boom operators (BO). One common thread to almost all the A/R related mishaps (28 Class B and C in the KC-135), independent of receiver type, was the lack of timely and assertive instruction/action by the BO. By no means am I saying that all of the mishaps were the BOs' "fault." However, any tanker crewmember worth his/her salt knows who's in charge during A/R. No mistaking Booms—you're in charge during A/R. Don't let a receiver put you (and no less important, the crews of both aircraft) in a bad situation. The timeliness of an action or instruction is essential to its effect during A/R. Even a short delay, in either actions or directions, by the BO directing A/R or the pilot maintaining aircraft control, can lead to a cascade of effects. We have seen it in the A/R mishaps this year. "Late to correct," "slow to respond," "delayed response," are all phrases that (when corresponding to the elements below) have led to mishaps.

The following common elements were gleaned from the year's A/R mishaps and merit renewed attention by the entire crew force:

- Allowing the receiver to ride the edge of the envelope
- Excessive receiver closure rate
- Receiver consistently not making corrections per BO instructions in a timely manner
- Accepting the same risk level on a training mission vs. operational mission
- Accepting the same risk level conducting training on an operational mission
- Crew not adequately prepared for autopilot disengagement
- Delaying disconnect past point of safe return
- Failure to apply down pressure in order to disconnect leading to brute force disconnect
- Not paying proper respect to existing A/R manual guidance

Of note, the overwhelming number of A/R mishaps did NOT occur on contingency missions. And, at the risk of postulating a specious explanation, I suggest that a continued high ops tempo and its accompanying "can do / must do" mindset has migrated into training missions where currency, qualification, and proficiency levels warrant a lower risk tolerance than that accustomed to in theater.

In summary: be directive—Insist on stabilized closure and insist on proper envelope limits. Recently, the block 40 modification and antennae placement on the KC-135 has caused some issues for receivers' reference points. However, if the AF decided to paint all the tankers white tomorrow it won't change the need for the BO to be directive with the receiver. If the receiver is consistently not where it needs to be or is non-responsive to BO direction, terminate A/R. I offer up a plagiarized phrase from an old tanker bud, "Back 5, back 10, back home." Pilots—back up your Booms. If it sounds like their life is being made difficult by the receiver, intervene. Anticipate—don't assume the receiver will arrest the closure. This is equally important for the BO and Pilot. For heavy receivers, be prepared for the autopilot to disengage at the worst moment. The autopilot's tendency to kick off during rapid closure or separation of a heavy receiver is well documented. And, while it's not a new phenomenon, it appears from some of the reports that we're not heeding existing guidance. Therefore, comply with existing guidance! Notes, warnings, and cautions exist for a reason. Don't pay lip service to them. Finally, don't take unnecessary risks. Pilots are taught in their first year of training that there's no peacetime requirement to fly through thunderstorms. Likewise, weigh the risk of pushing A/R with an unstable or unresponsive receiver. Ask yourself if it's worth the risk of ripping the boom off or punching a hole in the receiver aircraft … or worse?

As the Ops tempo continues at a high pace, I offer one parting plea. Let's get back to the A/R basics. For those of you in non-AMC commands, the following is an excerpt from a well-written Special Interest Item (SII) issued by AMC earlier this year. Here's to a safer year for the tanker force.

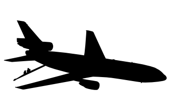
AMC
Subject: AMC SPECIAMC Special Interest Item (SII): Air Refueling Procedures
…2. Air refueling (a/r) mishaps are occuring at an alarming rate. In the past 6 months, there have been 14 reportable a/r boom-related mishaps, and 7 of the 14 have occurred in the past 5 weeks! From our research and perspective, there are two clear contributing factors: receiver instability—often precipitated by the receiver failing to obtain a stabilized precontact position with zero rate of closure, and a lack of assertiveness on the part of boom operators.

3. It is imperative that all receivers stabilize in the pre-contact position prior to approaching the boom. When cleared by the boom operator, approach the contact position at no greater than one foot per second, and remain stable in the a/r envelope.

4. AMC boom operators are the primary directors of safe air refueling operations. In this role, boom operators must aggressively direct air refueling operations. They will ensure receivers are stable in the precontact position prior to clearing them in for contacts, closely monitor the receiver's rate of closure, transmit prompt verbal corrections when necessary, disconnect from unstable receivers, and call breakaways when warranted. If a receiver closes too rapidly or becomes unstable, immediately direct the receiver back to the precontact position.

5. This air refueling mishap trend must stop. Whether we are operating in the aor or training at homestation, air refueling procedures must be the same. We cannot afford to damage anymore of our assets and lose combat capability. Bottom line—do it by the book, no exceptions."

*Note: For this discussion, drogue A/R mishaps are not included since these were due mostly to either materiel issues or the receiver as drivers in the mishap.



KC-10

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	1	1.63	2	3.26	0	0.00	0	0	61,268
5 YR AVG	1.2	1.84	2.2	3.38	0.0	0.00	0.0	0.0	65,084.0
10 YR AVG	0.8	1.40	1.5	2.62	0.0	0.00	0.0	0.0	57,203.0
LIFETIME CY81-FY06	12	1.04	20	1.73	0.0	0.00	0.0	0.0	1,156,573

Note: RC-135 hours are combined with all C-135 hours.

KC-135

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	15	6.33	0	0.00	0	0	236,531
5 YR AVG	0.4	0.16	8.8	3.62	0.0	0.00	0.0	0.0	242,808.0
10 YR AVG	0.4	0.18	5.3	2.40	0.1	0.05	0.2	0.4	220,671.8
LIFETIME CY57-FY06	81	0.61	169	1.27	64	0.48	134	629	13,331,594

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

MAJ BRIAN MUSSELMAN
HQ AFSC/SEFL
LT COL STEPHEN MOCZARY
HQ AFSC/SEFO

Surveillance/Recce

USAF Photo by SSgt Wayne Clark / Photo Illustration by Dan Harman

E-3B/C

The E-3 AWACS (Airborne Warning and Control System) community had zero Class A (FY05@0), two Class B (FY05@5) and four Class C (FY05@3) mishaps in FY06. Additionally, the AWACS experienced 92 (FY05@89) Class E events.

Class B

Internal engine damage discovered to number-four engine post-flight by maintenance. Damage is limited to high-pressure turbine.

During a post flight maintenance inspection, technicians discovered two damaged fourth-stage fan blades on the number-one engine. Subsequent borescope inspection confirmed further damage.

Class C

During maintenance post-flight inspection, blade damage was discovered in the third-stage of the high-pressure turbine (N1) compressor on the number-two engine. Significant damage was found on the third-through tenth-, twelfth-, thirteenth-, and sixteenth-stage compressor blades and stators. Some damage was caused domestically by two rivets which were liberated from the seventh-stage compressor stator assembly, and some damage was caused by a foreign object during a different incident.

During preflight, prior to engine start, a loud noise was heard, and all electrical power was lost. Maintenance found turbine blade fragments in the Auxiliary Power Unit (APU) exhaust and on the ramp. All damage was contained within the shroud. Analysis revealed that the APU failed using one of the standard failure modes. The APU is a fly to fail item. The average life of the component is three to four years. This particular APU was in service for eight years.

During an en route descent in IMC, the aircraft experienced a lightning strike on the left-hand side of the Mishap Aircraft (MA). Post-flight inspection discovered damage to the nose radome, VHF FM antenna, UHF antenna, HF antenna probe assembly and lightning arrestor inside the left wingtip.

After an uneventful sortie, post-flight inspection by the flight engineer confirmed metal pieces in the exhaust section of the number-four engine. Teardown revealed 90 percent damage to third- and fourth-stage blades of the N1. Teardown revealed the air seal failed, but could not determine the reason for failure. Turbine core showed no evidence of cause of damage.

Class E

Of the 92 Class E events, 48 were system/component failures. Of those 48, 34 (FY05@19) had smoke and/or fumes, 11 (FY05@8) engine shutdowns, two flight control problems and one pressurization problem. The remaining Class E events consisted of 41 (FY05@47) BASH events, two HATRs and one runway intrusion.

E-4B

The E-4 National Airborne Operations Center (NAOC) community had zero Class A (FY05@1), zero Class B (FY05@1), and one Class C (FY05@1) mishaps this year. There were 21 (FY05@28) Class E events for the E-4 this year.

Class C

While in the traffic pattern the left body landing gear oleo door liberated from the aircraft, damaging panel number 192BL, due to extensive oxidation on two of the three oleo door hinges.

Class E

All 21 Class E events were BASH reports.

E-8C

The E-8 Joint Surveillance and Target Attack Radar System (JSTARS) had zero Class A (FY05@0), zero Class B (FY05@2), and six Class C (FY05@4) mishaps. There were 93 (FY05@68) Class Es.

Class C

During a local traffic pattern sortie the number-two utility hydraulic low pressure lights illuminated due to a sheared internal filter cap on the nose landing gear steering metering valve. During landing roll, the crew experienced nose landing gear oscillations, and were unable to maintain directional control of the aircraft. The aircraft was brought to a full stop on the runway shoulder.

During climb out the number-two engine fire light illuminated due to hot spots at or near the leading edge of the aft Thrust Reverser (TR) assembly. The TR assembly was discovered to be warped at the ten and twelve o'clock positions along with a damaged aft TR seal.

During flight the crew observed the number-one engine oil low pressure light flickering a few times, then remaining illuminated. After placing the engine in idle, the light remained illuminated due to rapidly decreasing oil pressure. The engine was shutdown. Maintenance back shop was unable to rectify the low oil pressure and oil leaks, and the engine was shipped to the depot for investigation and overhaul.

During air refueling, the number-one engine oil pressure gauge dropped below limits with a corresponding low oil pressure warning light illuminated due to metal chunks and shavings in the oil filters (caused by scavenge pump lower drive gear bearing failure). The engine was shutdown.

During go-around the number-two engine EGT reached 595 degrees C for 45 seconds. The engine was shutdown. Due to EGT engine change criteria the engine was shipped to depot for overhaul.

Shortly after the flaps were retracted on takeoff climb out, the number-three engine oil pressure light flickered and the oil pressure gauge showed rapid fluctuation between 20 and 90 PSI. The crew performed a precautionary engine shutdown.

Class E

Of the 93 Class E events, 31 were system/component failures. Of those 31, 13 resulted in smoke and/or fumes (three had physiological effects), 12 (FY05@14) engine shutdowns (seven engine oil related and five other), four miscellaneous events (slat restrictor valve/missing latch/window shattered/number seven TRU), and two physiological events due to cabin pressurization problems. The remaining Class E events consisted of 61 (FY05@44) BASH reports, and one HATR (FY05@2).

RC-135V/W/S/U

The RC-135 Rivet Joint/Combat Sent/Cobra Ball community experienced zero Class A (FY05@0), zero Class B (FY05@1) and three Class C (FY05@2) mishaps this year. They also had 67 (FY05@78) Class E events.

Class C

Sometime during landing, an F-108 engine equipped RC-135V made contact with the number-three engine on the runway causing scraping on the number-three cowling.

During step five of the ENGINE SHUTDOWN checklist, the pilot pressed the Emergency Avionics System (EAS) deploy button causing the EAS airfoil to depart the aircraft and fall onto the pavement.

After departing the active runway to enter the taxiway, the nose strut was damaged by an unsecured wheel due to nose wheel bearing failure.

Class E

Of the 67 Class E events, 14 were system/component failures. Of those 14, seven (FY05@3) were smoke and/or fumes, four physiological (FY05@2) (sinus blockx2, ear block, trapped gas), one hard landing, one radio/comms, and one (FY05@2) HATR. The other 53 (FY05@57) Class E events were BASH reports.

U-2S

The U-2 Dragon Lady experienced zero Class A (FY05@1), zero Class B (FY05@1) and four Class C (FY05@8) mishaps this year. In addition, the community also had fourteen Class E (FY05@9) events.

Class C

While on final for a full stop, the Mishap Pilot (MP) heard a noise. Following landing, maintenance found bird remains. The Mishap Engine (ME) had significant damage to the leading edges of 11 fan blades and 11 compressor blades in the first, second, third and ninth stages of the engine.

Windscreen damage caused by a faulty anti-fog controller. The windscreen heating element overheated due to improper input from the controller, causing delamination and a hairline crack in the windscreen.

MP suffered from severe Type II Decompression Sickness (DCS) with neurological compromise and incipient cardiovascular collapse.

During landing with high wind gusts the nose of the aircraft began to veer right. Despite pilot attempts to correct toward centerline, the aircraft continued to veer right with full left rudder and the left wing pinned on the runway. The pilot shut the engine down prior to runway departure.

Class E

There were 14 Class E events for the year. Four were physiological incidents, of which three were classified as DCS, and one was abdominal pain. There was one HAP, and the remaining nine events were BASH reports.

E-3

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	2	11.61	0	0.0	0	0	17,233
5 YR AVG	0.0	0.00	1.8	8.62	0.0	0.00	0.0	0.0	20,877.4
10 YR AVG	0.0	0.00	1.0	4.84	0.0	0.00	0.0	2.0	20,662.1
LIFETIME CY77-FY06	1	0.15	12	1.77	1	0.15	2	24	678,543

E-4

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	1	0.00	0	0.00	0	0.00	0	0	1,754
5 YR AVG	0.6	38.06	0.8	50.74	0.0	0.00	0.0	0.0	1,576.6
10 YR AVG	0.3	20.10	0.6	40.19	0.0	0.00	0.0	0.0	1,492.9
LIFETIME CY75-FY06	5	9.53	8	15.24	0	0.00	0	0	52,477

E-8

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	0	0.00	0	0.00	0	0	12,176
5 YR AVG	0.0	0.00	0.2	2.03	0.0	0.00	0.0	0.0	9,837.8
10 YR AVG	0.1	1.52	0.2	3.05	0.0	0.00	0.0	0.0	6,567.1
LIFETIME FY91-FY06	1	1.45	2	2.89	0	0.00	0	0	69,122

RC-135

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	15	6.33	0	0.00	0	0	236,531
5 YR AVG	0.4	0.16	8.8	3.62	0.0	0.00	0.0	0.0	242,808.0
10 YR AVG	0.4	0.18	5.3	2.40	0.1	0.05	0.2	0.4	220,671.8
LIFETIME CY57-FY06	81	0.61	169	1.27	64	0.48	134	629	13,331,594

Note: RC-135 hours are combined with all C-135 hours.

U-2

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	0	0.00	0	0.00	0	0	14,512
5 YR AVG	0.6	4.35	0.0	0.00	0.4	2.90	0.2	0.2	13,778.8
10 YR AVG	0.6	4.80	0.0	0.00	0.2	1.60	0.1	0.1	12,508.2
LIFETIME CY63-FY06	30	6.42	1	0.21	22	4.71	8	13	467,078

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

BASH

LT COL TED WILKENS
1LT LAURA STEPKO
HQ AFSC/SEFW

USAF Photo by A1C Christopher L. Ingersoll / Photo Illustration by Dan Harman

Another fiscal year has come to a close, and that means it is time to review some numbers. For the first time in seven years, strike reporting decreased with 5,076 strikes recorded. This is down from a record high in FY05 when 5,128 strikes were recorded. Statistical data from Safety Automated System reports indicated that 98 percent (4,987) of the bird strikes were Class E events. All those Class E events added up to $861,604 (5 percent) of the total damage cost. We experienced two Class A mishaps accounting for $7,657,621 (48 percent) of our total FY06 cost of $15,999,365. One aircraft crashed as an indirect result from a bird strike, but (fortunately) no Airmen were lost. There were six Class B and 81 Class C wildlife mishaps resulting in $7,480,140 (47 percent) of the total damage cost.

As expected, about 42 percent of our strikes occurred in the airfield environment while nine percent occurred during low-level and range operations. These statistics are roughly the same as years past, but the "unknown" flight phase category continues to increase. Typically, most damage occurs in low-level and range operations when aircraft are flying fast in wildlife saturated airspace. This year's statistics continue to emphasize that point. The low-level Class A event accounted for 41 percent of the total damage while the airfield environment Class A event accounted for seven percent.

The top ten species struck include many familiar names, the "usual suspects" 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. However, Killdeer and Eastern/Western Meadowlarks continue to inflict great damage despite their small size. Killdeer accounted for

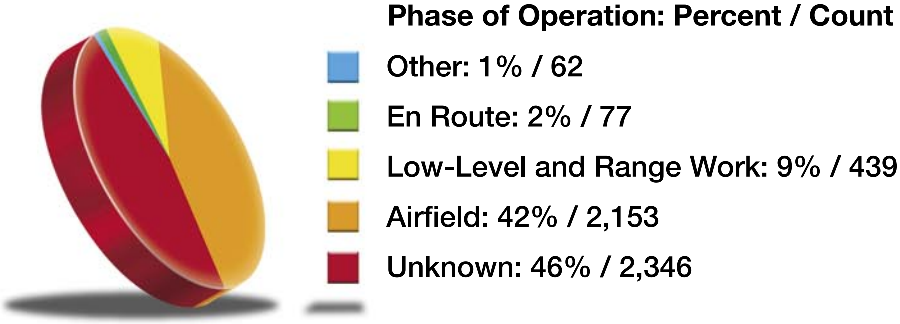
FY05 Top 10 Wildlife Strikes by Count

Common Name	# Strikes	Cost
Perching Birds	399	$211,091
Swallows	213	$79,188
Horned Lark	204	$79,605
American Mourning Dove	198	$385,893
Eastern/Western Meadowlark	111	$343,801
Bats (Mammals)	111	$59,593
Killdeer	78	$447,817
Sparrow	76	$99,547
Swifts	73	$68,100
Thrush	66	$69,138
Total	1,529	$1,843,773

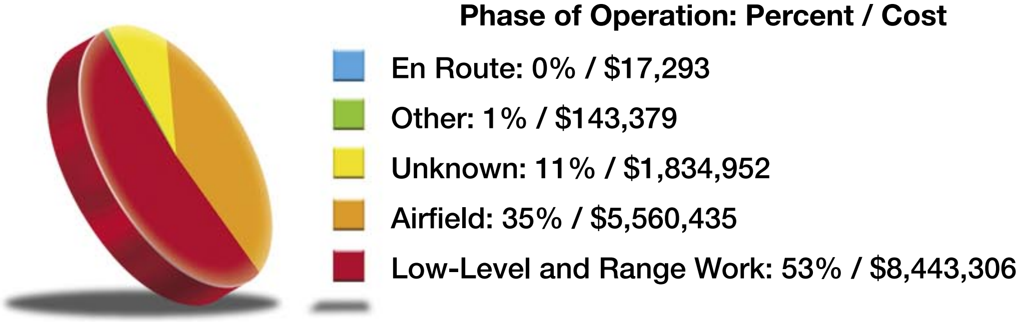
FY05 Top 10 Wildlife Strikes by Cost

Common Name	Cost	# Strikes
Black Vulture	$6,664,497	16
Swainson's Hawk	$1,172,969	9
Mallard	$775,149	1
Gulls	$723,744	30
Snowy Owl	$558,000	1
Killdeer	$447,817	78
Turkey Vulture	$437,225	30
American Mourning Dove	$353,893	198
Eastern/Western Meadowlark	$343,801	111
Red-Tailed Hawk	$247,695	34
Total	$11,704,790	508

FY06 Bird Strikes
Phase of Operation: Percent / Count



FY06 Bird Strikes
Phase of Operation: Percent / Cost



only 78 strikes, but amassed $447,817 in damage. Meadowlarks accounted for 111 strikes, but totaled $343,801 in damage. It was no surprise that vultures, raptors, and gulls caused large amounts of damage with low reported strike events.

One Class A mishap involved a T-38 striking a Black Vulture on the canopy while climbing to avoid obstructions on a low-level route in Texas. The other Class A mishap occurred when an F-16 struck a Swainson's Hawk during initial climb inside the airfield environment. Both mishaps involved single birds. Detailed mission scheduling and planning, proper risk management assessment, and extreme vigilance during operations must be exercised when executing flight operations in areas forecasted to have increased bird activity. When properly employed, tools such as the Avian Hazard Avoidance System (AHAS) and Bird Avoidance Model (BAM) can assist aircrew in making smart decisions in how and where they fly.

Of the six Class B events, two occurred near the airfield, two occurred during low-level and range operations, and the remaining two were marked unknown. A single Killdeer caused $440,000 damage to an F-22 when it was ingested by the number-two engine. A Snowy Owl caused $558,000 damage to a C-130E during the takeoff phase. Total cost damage is expected to increase due to two ongoing Class B event investigations.

Every effort should be made to decrease the unidentified species category (50 percent). Strike remains, if available, are required to be sent to the Smithsonian Institution for positive identification per compliance-based AFI 91-223. Remains identification using DNA is becoming commonplace in pinpointing species when only small amounts of material are available. We attribute many unknowns this year to the overseas outbreak of H5N1 Avian Flu. Collection and shipping from overseas locations were halted earlier in the year, but have since resumed. Domestic collection and shipping of remains have not changed. New procedures for collecting and shipping remains from overseas countries were coordinated with the HAF Surgeon General and are now being included in maintenance directives. Approved remains collection procedures for overseas locations are posted at http://afsafety.af.mil/SEF/Bash/SEFW_new.shtml and were distributed to all MAJCOM SEFs.

The BASH team continues to research and harness technology to alert crews in real time of potential wildlife strikes. Plans are proceeding to combine the BAM and AHAS into one system with more detailed and accurate information. The new system will continue to provide bird advisory updates every six minutes. USAF contractors are experimenting with three-dimensional fly-through displays and improved imagery. All improvements will make these systems more reliable as planning and front-line advisory tools.

Small Mobile Radar (SMR) testing is beginning at Dover and will soon be at Langley and Whiteman as well. Different SMR operational concepts for fielding this real-time wildlife warning tool at home and deployed locations are being explored.

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.

USAF Photo by TSgt Scott T. Sturkol
Photo Illustration by Dan Harman

Maintenance

CMSGT SANDY STACY
HQ AFSC/SEFO

Well, fellow maintainers, it's the time of year where we look back at how well we maintained our aircraft in FY06. We all know we do great things on a day-to-day basis, but now and then we do something "not quite right." Fortunately, we didn't kill anyone this year, but we did do some damage to our airplanes. However, our overall maintenance mishap numbers are down … WELL DONE!

I know it's difficult these days to balance fighting the War on Terror with doing good quality maintenance, but that's exactly what we have to do. Maintainers are famous (or maybe infamous would be a better word) for finding creative ways to fix airplanes. Unfortunately, we continue to make work for ourselves by failing to follow technical data, installing the wrong parts, FODing out aircraft and general complacency in doing our jobs. We need to start policing each other on the flightline and in the backshops. Heard this before? I know I've heard it and ultimately said it many, many times in my 26 years in maintenance.

In the following paragraphs, I'll provide some examples of what we've done wrong that ended up costing the Air Force money and ourselves a lot of extra work. Our Class A mishaps stayed about the same, but you've done a good job keeping the Class Bs and Cs low this year.

Class A Mishaps

F-16C. Main landing gear tire blew on landing, and the aircraft departed the runway, collapsing the left main landing gear. Maintenance failed to track the number of landings since the tires were installed. The result … $7.3M in damage.

F-22A. During launch procedures the nose landing gear pin was ingested into an engine. Maintenance, violating tech data, left the pin installed to perform another task after engine start. After removing the pin, the maintainer failed to secure it and the operating engine sucked it in. The result … $6.7M in damage.

F-15C. During recovery procedures the nose landing gear pin was ingested into an engine. The recovery assistant approached the aircraft to install the pin and the still operating engine sucked it in. The assistant was unqualified and unsupervised, a violation of our basic training procedures. The result … $1.3M in damage.

Class B Mishaps

F-15C. Main landing gear failed on landing, and aircraft departed the runway. Maintenance improperly installed the inboard downlock spring on the left main landing gear, and failed to perform operational checks on the hydraulic system which allowed a significant amount of air in the system. The result … $609K in damage.

F-15E. During an FCF, the left variable inlet ramp separated from the aircraft and was ingested into the number-one engine. Maintenance failed to properly install an inlet hinge pin, and improperly performed the alignment inspection. The result … $246K in damage.

A-10A. During takeoff, the pilot noted a decrease in performance of the right engine. He declared an IFE and landed. Maintenance found the remains of a water intrusion plug in the engine cowling. During preflight the maintainer did not follow tech data for removal of the plugs and left one installed. The result … $477K in damage.

Class C Mishaps

Our Class C mishaps were the lowest in six years, 30 to be exact. We've damaged fighters, tankers, bombers, cargo carriers and even an uninstalled engine. Since the list is pretty long, here's a synopsis of what went wrong.

- One instance of improper use of safety gear … maintainer fell off aircraft and damaged aircraft and himself
- Two cases of equipment being ingested into engines … a comm cord and a video tape
- Two cases of FOD … a rivet and a screw
- Two cases of incorrectly installing parts … bolts not safetied x 2
- Three times we installed the wrong part … a nose wheel bearing, one-time bolts were re-used, and incorrect nutplates used in proximity to the intake
- Three instances where we failed to install parts … failed to transfer a bearing to the new part, didn't install a slip bushing, and failed to install a mounting bracket
- Four times we managed to run into stands … twice we ran a perfectly good aircraft into the stands and twice we didn't move the stand out of the way during operational checks
- And the number one cause of Class C mishaps? Thirteen times we failed to follow tech data! We failed to remove bolts in proper sequence, didn't align a missile on the rail correctly, dropped parts, didn't install chocks, used unapproved procedures, and didn't document follow-on maintenance, just to name a few.

Summary

How many times have you heard in roll call "follow technical data," "make sure you document the aircraft forms," "use your safety gear?" And how about "If you don't know what you're doing, ask for help?" All good advice, and if you've been a maintainer more than 30 days, you probably automatically tune these words out. After reading this article you should know that tuning out that information is exactly NOT what you should be doing. With experience levels continuing to be an issue, it is more important than ever to do maintenance by the book. I learned a long time ago that the best way to do maintenance is to do it right the first time. Why, you might ask? If you fix the aircraft right the first time, it won't repeat the next flight/day and you won't have to go out to do the same task again. If you follow the book, you won't hurt yourself or your buddy. If you follow the book, you won't damage the aircraft. If you follow the book, then when the aircrew gets in the aircraft you know that you've done your best. They will have a safe mission and bring themselves and the aircraft back home.

Every one of you works extremely hard. You work in the rain, the snow, the heat and the cold. You rotate to the desert and back again. You take pride in your work, and most of you wouldn't work in an office for any reason. You fix airplanes at night in the dark for the early morning takeoff, and sometimes you're tasked to make the impossible, possible. When you're doing all these things, remember this; if you aren't using the book, wearing your PPE, or writing in the aircraft forms, you're doing it wrong. Yes, there's pressure to get the aircraft launched, but don't let that make you be unsafe. If you're a supervisor, it's even more important to do it right. The Airmen that follow your example will follow the bad just as quickly as they do the good. Be the kind of boss you want to follow. Know your job, take care of your subordinates and take pride in what you do for your country.

Trainers

LT COL LONNY BEAL
MAJ TIM ARNOLD
MAJ TOM FERENCZHALMY
HQ AFSC/SEF

T-1

For FY06 the T-1 community posted another banner year in regards to aviation: a third straight year without a Class A mishap, and a second year with no Class B mishaps. Repeating FY05's performance, the T-1 experienced only three Class C mishaps. Two of the Class C mishaps resulted from aircraft bird strikes, while the third mishap involved an engine overtemp which is still under investigation.

The two Class C bird strikes combined with 142 Class E bird strikes as the biggest trend in the T-1. Because the difference between a Class E, Class B, or Class A bird strike is often luck, this is a trend worthy of attention. Aircrews must continue mitigating this hazard through use of BAM, AHAS, local bird monitoring, in-flight vigilance, and sound risk management.

Outside of bird strikes, the T-1 experienced 43 Class E incidents compared to 24 in FY05 and 54 in FY04. Smoke and fumes (14 events) and trim malfunctions (nine) accounted for over 50 percent of these events. Both areas are previously identified trends.

The T-1 was also involved in four reported Near Mid-Air Collisions, one on a low-level and three in VMC conditions in the radar pattern. These potential disasters highlight the need for pilots to "see and avoid" any time they are operating in VMC, regardless of clearance or phase of flight.

T-6

The T-6 continued a two-year run without a Class A mishap. While Class Bs jumped from zero to two, Class C mishaps decreased from 14 in FY05 to nine in FY06. One trend worth noting is two mishaps involved inadvertent activation of egress systems during ground operations. An inadvertent ejection before takeoff resulted in a Class B and relatively unharmed pilot. A Class C mishap resulted from an inadvertent activation of the Canopy Fracture System (CFS). Both of these mishaps highlight the need to "fly" the sortie from engine start to shutdown.

The second Class B involved an intentional gear up landing, the fourth such event in the last five years. Two chip light events resulted in


USAF Photo by MSgt Val Gempis
Photo Illustration by Dan Harman

Class C engine damage, and Attitude Heading Reference System (AHRS) failures continued, with eight in FY06. The only other trend to point out was seven Class E events with smoke or fumes in the cockpit.

T-37

The ever-shrinking T-37 fleet experienced zero Class As or Bs in FY06. A total of 11 Class Cs occurred with six due to a variety of engine damage, two bird strikes, one physiological, one asymmetric flap and one abnormal runway contact. Smoke-and-fumes and physiological incidents (G-LOCs and hypoxia) continue to be the vast majority of all Class E events.

The Class C due to abnormal runway contact occurred during a no-flap pattern and landing. The aircraft touched down firmly and the right main landing gear strut failed causing the aircraft to skid off of the runway. Both crewmembers egressed safely.

The physiological mishap occurred during the RTB portion of an out-and-back student sortie. While at altitude, the student pilot began experiencing hypoxic symptoms. The crew recovered the aircraft uneventfully, yet the student pilot continued to experience symptoms. The student pilot was grounded indefinitely pending diagnosis of his symptoms.

The mighty "Tweet" is gradually being phased out of the flying inventory, with the last aircraft to be decommissioned sometime in FY09.

T-38

The T-38 experienced two Class As in FY06 with one destroyed aircraft, but no fatalities. The first occurred during the low-level portion of a student training mission when the aircraft struck a large bird, which penetrated the front canopy. The crew immediately climbed away from the ground and turned towards their home field. During recovery to home base, the aircraft descended to an unsafe altitude and the crew ejected. Both crewmembers survived, although the Instructor Pilot (IP) sustained serious injuries.

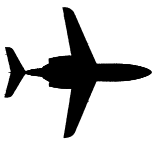
The second Class A occurred during an instrument approach at an out-base. The mishap aircraft touched down well short of the runway in the unprepared under-run, and contacted the 2-3 inch lip on the end of the runway. The aircraft sustained severe damage to the landing gear and wing assemblies, but was recovered via a gear-up landing at the home base. Neither crew member was injured.

The sole Class B occurred when a T-38 experienced an engine failure during takeoff resulting in a hydraulic fire. The takeoff was successfully aborted, and the crew egressed without incident or injury. The fire department was able to extinguish the fire.

The T-38 experienced 46 Class Cs throughout FY06. The majority of these were attributed to engine damage. Of the remainder, ten were due to bird strikes and three were due to loss of a canopy.

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 ten years. The T-43 didn't even have a single Class C mishap in FY06. Reported Class E events for FY06 were up from 11 in FY05 to 13 in FY06. Of the 13 Class E events, all but one was a bird strike. The only non-BASH-related class E was a Bearing Distance Heading Indicator failure in flight. Much of the success can be attributed to the fairly benign mission of the T-43 and the fact that this MDS logs less than 5,000 operational flying hours annually, but the great news is that they continue to build upon an almost spotless safety record year after year.

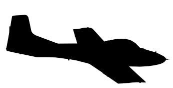


T-1

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	0	0.00	0	0.00	0	0	100,602
5 YR AVG	0.2	0.20	0.4	0.39	0.0	0.00	0.0	0.0	101,840.4
10 YR AVG	0.1	0.10	0.8	0.81	0.0	0.00	0.0	0.0	99,307.6
LIFETIME FY92-FY06	1	0.09	8	0.74	0	0.00	0	0	1,085,138

T-6

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	0	0.00	0	0.00	0	0	108,495
5 YR AVG	0.2	0.30	0.6	0.91	0.2	0.30	0.4	0.4	66,160.2
LIFETIME FY00-FY06	2	0.59	4	1.18	2	0.59	2	2	339,402



T-37

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	0	0.00	0	0.00	0	0	93,572
5 YR AVG	0.6	0.41	0.0	0.00	0.6	0.41	0.2	0.4	145,848.8
10 YR AVG	0.6	0.36	0.0	0.00	0.6	0.36	0.1	0.3	167,737.0
LIFETIME CY56-FY06	138	1.03	31	0.23	136	1.01	27	78	13,452,270

T-38

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	2	1.57	1	0.79	1	0.79	0	0	127,261
5 YR AVG	1.0	0.73	1.2	0.88	0.6	0.44	0.2	0.2	136,385.8
10 YR AVG	0.7	0.50	0.9	0.65	0.6	0.43	0.1	0.4	139,042.5
LIFETIME CY60-FY06	196	1.47	98	0.74	188	1.41	76	138	13,320,784

T-43

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	0	0.00	0	0.00	0	0	3,806
5 YR AVG	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.0	4,375.6
10 YR AVG	0.1	0.00	0.0	0.00	0.0	0.00	0.0	0.0	4,955.4
LIFETIME CY74-FY05	1	0.29	6	1.77	1	0.29	2	35	360,980

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

UAS

LT COL CHUCK KOWITZ
HQ AFSC/SEFF

USAF Photo by SSgt Tony R. Tolley
Photo Illustration by Dan Harman

Unmanned Aerial Systems (UAS) continue to play a vital role in the Global War on Terror. With their high endurance, Air Force UASs provide Combatant Commander's flexible Intelligence, Surveillance and Reconnaissance, and precision weapon options. Options that make UASs an important resource to national defense.

The Air Force has a myriad of UAS platforms. The main platforms are the MQ-1 Predator, the RQ-4 Global Hawk, the MQ-9 Reaper, the QF-4 Full Scale Aerial Target and the Tethered Aerostat Radar System.

MQ-1 Predator

The MQ-1 Predator is a medium-altitude, long-endurance UAS. Its primary mission: interdiction and armed reconnaissance. The basic crew for the Predator is one pilot and one sensor operator. They control the aircraft from inside the Ground Control Station (GCS) via a satellite data link for beyond line-of-sight flight. The aircraft is equipped with a color nose camera (generally used by the pilot for flight and ground control), a day variable-aperture TV camera, a variable-aperture infrared camera (for low light/night), or a Synthetic Aperture Radar (SAR) for looking through smoke, clouds or haze. The cameras produce full motion video while the SAR produces still frame radar images.

The MQ-1 Predator carries the Multi-spectral Targeting System (MTS) with inherent AGM-114 Hellfire missile targeting capability and integrates electro-optical, infrared, laser designator and laser illuminator into a single sensor package. The Predator can employ two laser-guided Hellfire anti-tank missiles with the MTS ball. The cost of one Pedator is approximately $5 million. Unlike the Global Hawk, the Predator does not have an auto land feature.

In FY06, the Predator had four Class A mishaps, six Class C mishaps and 16 Class E events. Two of the four Class A mishaps were related to the poor ergonomic layout of switches in the GCS. One Class A was was a mechanical failure, and one was a landing mishap. Two of the Class C mishaps were during the landing phase of flight. The other four Class C mishaps were all engine-related. Of the 16 Class E events, six were related to near mid-air collisions, three were bird strikes, two were propulsion-related, two were ground taxi events, two were GCS battery malfunctions and one was a departure from controlled flight.

USAF Photo by TSgt Jack Braden
Photo Illustration by Dan Harman

RQ-4 Global Hawk

The Global Hawk UAS provides Air Force and joint battlefield commanders with near-real-time, high-resolution intelligence, surveillance and reconnaissance imagery. Once mission parameters are programmed into Global Hawk, the UAS can autonomously taxi, takeoff, fly, remain on station capturing imagery, return and land. Ground-based operators monitor the RQ-4 health and status, and can change navigation and sensor plans during flight, as necessary. The Global Hawk cruises at altitudes up to 65,000 feet and has a range up to 12,000 nautical miles. With its cloud penetrating Synthetic Aperture Radar the RQ-4 can survey large geographic areas with pinpoint accuracy. The Global Hawk has a wingspan of 116 feet, is 44 feet long, and when fully-fueled it weighs 25,600 pounds.

In FY06 the Global Hawk had four Class E events. Two were unintentional changes in altitude, one was a malfunction with the onboard environmental control system causing early mission termination, and the fourth was an uncommanded go-around from short final.

MQ-9 Reaper

The MQ-9 Reaper is the Air Force's first hunter-killer UAS. The airframe resembles the MQ-1. However, it is larger and more powerful than the Predator, and is designed to go after time-sensitive targets with persistence and precision, and destroy or disable those targets with 500 pound bombs and Hellfire Missiles. The Reaper can stay airborne for up to 14 hours fully loaded. It has a 900-horspower turbo-prop engine and a wingspan of 64 feet.

The Reaper has an integrated sensor suite with a moving target-capable synthetic aperture radar and a turret that houses an electro-optical sensor, an infrared sensor, a laser range finder and a laser target designator. It carries more than 15 times the ordnance of the Predator, while flying almost three times the Predator's cruise speed.

General T. Michael Mosely explained that, "we've moved from using UAVs primarily in intelligence, surveillance and reconnaissance roles before Operation IRAQI FREEDOM, to a true hunter-killer role with the Reaper." The Air Force currently has seven MQ-9 Reapers in its inventory.

In FY06 the Reaper experienced one Class A mishap when it landed short. Additionally, there was one Class E event in the Reaper community involving a near mid-air with a 747 at a deployed location.

QF-4 Full-Scale Aerial Target And Aerostat

There were no reported Aerostat mishaps in FY06. The QF-4 had a total of six reported mishaps. Two unmanned Class As were due to unstable pitch control caused by component failures. There were two BASH Class Es. One manned Class E was due to unstable pitch control caused by a component failure, but fortunately, the on-board pilot took control and safely recovered the aircraft. Finally, there was one manned Class E involving a gear up touch-and-go.

UAS Mid-Air Collision Hazard

Class E events, by design, identify hazards that could eventually cause reportable mishaps (Class A, B or C). Also, Class E report recommendations provide risk mitigation alternatives. Essentially Class E reports accomplish the first four steps of Operational Risk Management, and are most useful in the prevention of future mishaps.

In FY06 there were a total of seven Class E events dealing with mid-air collision hazards for both the Pedator and the Reaper communities. These are just the near mid-airs reported by the Pedator and Reaper communities. Not all of the UAS/manned aircraft near mid-air events were detected by the UAS community. As a result the number of near mid-airs is greater when you consider the reports filed by manned aircraft. Because of the mid-air potential with manned aircraft, traffic collision and avoidance in all UAS communities is a major concern.

An integral part of flight path deconfliction in manned aircraft, whether VFR or IFR, is the "see and avoid" principle. The equivalent for UASs is "detect and avoid." Unfortunately, most UASs are not able to "detect and avoid" given the limitations ground-based pilots have with the available sensors.

Presently, Predator and Reaper aircrew rely on either the nose camera or the MTS cameras to "detect and avoid." Using these sensors can be equated to "looking through a straw." Scanning for traffic is difficult, and when identified, distance and altitude judgment is often inaccurate. Other UAS tools used to increase situational awareness of manned aircraft are Link-16, Air Traffic Control advisories and vigilant monitoring of radio traffic. However, UAS aircrew do not have the luxury of a sanitized cockpit environment working in the GCS, and as a result these other flight path deconfliction tools, are also limited. Finally, UAS operators further mitigate the mid-air collision hazard through strict airspace planning and procedures. This is especially the case when flying within the US airspace structure as UASs are not currently allowed to file and fly like manned aircraft. Instead they currently operate in special use airspace or in specially sanitized airspace coordinated with the FAA.

Military Standard 882D identifies the optimum choice in mitigating a hazard for a weapon system is to "design out" the hazard. In the case of UASs, this means having sensors that, as a minimum, emulate a human pilot in accomplishing flight path deconfliction. The Traffic Collision Avoidance System (TCAS) would greatly mitigate the UAS mid-air collision hazard. Numerous near mid-air events filed by manned aircraft are first detected with TCAS. But TCAS is not a complete solution as it only detects aircraft with an operational transponder. At this time, there is no off-the-shelf technology that emulates an onboard human pilot to accomplish UAS flight path deconfliction. Fortunately, the Air Force Research Laboratory and the Aeronautical Systems Center at Wright-Patterson AFB are developing technologies beyond the human pilot capabilities. They are also developing technologies that will enable UASs to autonomously maneuver upon detecting a conflict. Such technologies will assist in "designing out" the UAS mid-air collision hazard. But, even when the technology is developed, funding must be made available to finally enable UASs to "detect and avoid."

Until UASs are equipped to "detect and avoid," UAS operators must continue to diligently use their limited sensors to their full capability. Further, airspace planners must thoroughly accommodate the current UAS limitations. Equally, it is paramount that manned aircraft aircrew know the deconfliction plan and remain vigilant when operating in proximity to UASs. In closing, until the UAS mid-air collision hazard is "designed out," both thorough airspace planning and vigilant flight path deconfliction are necessary intermediate mitigation measures.

USAF Photo
Photo Illustration by Dan Harman

M/RQ-1

Year	Class A		Class B		Destroyed		Hours
	No.	Rate	No.	Rate	A/C	Rate	
FY06	4	6.92	0	0.00	2	3.46	57,798
5 YR AVG	4.2	12.35	0.2	0.59	3.2	9.41	34,005
10 YR AVG	5.8	14.87	0.6	1.54	4.8	12.30	39,014.4
LIFETIME FY94-FY06	29	14.87	3	1.54	24	12.30	195,072

RQ-4

Year	Class A		Class B		Destroyed		Hours
	No.	Rate	No.	Rate	A/C	Rate	
FY06	0	0.00	0	0.00	0	0.00	2,574
5 YR AVG	0.4	47.40	0.2	23.70	0.4	47.40	843.8
LIFETIME FY00-FY06	4	94.81	1	23.70	3	71.11	4,219

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

Helicopters

LT COL THOMAS ROY
HQ AFSC SEFF

FY06 was a banner year for US Air Force helicopter mishap prevention! Although the highly demanding mission requirements did not yield, the USAF didn't experience any Class A helicopter mishaps in FY06. The Class B and C mishap rates were also well below ten-year averages. These statistics are a true testament to the exceptional skills and judgment of our HH-60, MH-53 and UH-1 aircrews.

The HH-60 experienced three Class B and 11 Class C mishaps in FY06. The Class Bs included main-rotor to SATCOM antennae contact, a refueling probe oscillation and a rappelling mishap. The first of FY06 involved an HH-60 main rotor impacting the SATCOM antennae on the aft deck during aero braking. The cause, somewhat familiar in our community, was an aft cyclic input following significant collective reduction. The second Class B was airframe damage, and near control loss resulting from severe refueling probe oscillation. This mishap was the most concerning helicopter mishap of FY06 due to additional H-60 severe oscillation events/mishaps occurring in the recent past, and an absence of any clear root cause. The H-60 Systems Safety Group is aggressively pursuing the cause of, and mitigation measures for these oscillations. The third and final H-60 Class B of FY06 was a physical injury that occurred during H-60 rappelling operations. The Airman on rappel lost control of the rope with his brake hand due to rope twist, and the use of a "figure eight" device that is no longer authorized for use. This mishap has resulted in heightened inspection/control of all Alternate Insertion/Extraction (AIE) equipment within the USAF rotary wing community.

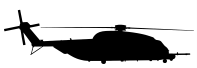
The MH-53 experienced two Class B and eight Class C mishaps in FY06. Both Class Bs were engine-related. The first Class B mishap of FY06 resulted from bearing seizure of the number-one engine-oil cooler bearing and subsequent failure of the oil cooler drive belt. The failed oil cooler rapidly progressed to an engine oil over-temp. The second Class B resulted from an overly aggressive collective pull on approach to a landing zone that transiently increased the GG rotor speed to 110 percent.

The UH-1 also experienced two engine-related Class B mishaps in FY06 along with four Class C Mishaps. The first Class B involved an engine over-speed for undetermined reasons that immediately followed transition to manual engine governing. The second resulted from the failure of an incorrect part numbered steel (as opposed to Teflon) NF governor coupler that also resulted in engine over-speed.

Once again, a great year for rotary wing mishap prevention. As of this writing, there are no reported Class A mishaps in FY07. Keep up the great work, focus on risk management and fly safe!

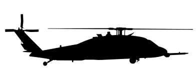
H-1

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	2	7.61	0	0.00	0	0	26,285
5 YR AVG	0.2	0.89	0.6	2.68	0.2	0.89	0.0	0.0	22,427.8
10 YR AVG	0.3	1.42	0.3	1.42	0.3	1.42	0.0	0.0	21,090.2
LIFETIME CY59-FY06	54	3.17	17	1.00	40	2.35	21	52	1,700,873



H-53

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	1	10.60	0	0.00	0	0	9,433
5 YR AVG	2.0	19.39	2.4	23.26	0.6	5.82	0.2	1.0	10,316.4
10 YR AVG	1.2	10.00	1.6	13.33	0.4	3.33	0.1	0.6	12,000.9
LIFETIME CY66-FY06	38	7.49	31	6.11	23	4.54	25	86	507,129



H-60

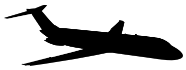
Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	2	7.36	0	0.00	0	2	27,190
5 YR AVG	1.8	6.90	0.8	3.07	0.8	3.07	0.4	1.6	26,086.6
10 YR AVG	1.1	4.21	0.4	1.53	0.6	2.30	0.6	2.0	26,097.8
LIFETIME FY82-FY06	18	4.18	6	1.39	11	2.55	11	42	430,773

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

USAF Photos
Photo Illustration by Dan Harman

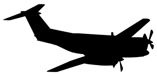
Others

USAF and USN Photos
Photo Illustration by Dan Harman



C-9

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	0	0.00	0	0.00	0	0	892
5 YR AVG	0.0	0.00	0.8	8.82	0.0	0.00	0.0	0.0	9,072.0
10 YR AVG	0.1	0.66	0.4	2.64	0.0	0.00	0.0	0.0	15,130.6
LIFETIME CY68-FY06	3	0.33	6	0.67	1	0.11	3	3	898,027

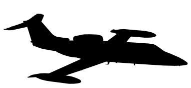


C-12

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	0	0.00	0	0.00	0	0	5,096
5 YR AVG	0.0	0.00	0.4	9.25	0.0	0.00	0.0	0.0	4,322.0
10 YR AVG	0.0	0.00	0.2	4.54	0.0	0.00	0.0	0.0	4,403.4
LIFETIME CY75-FY06	2	0.47	3	0.71	1	0.24	2	6	422,414

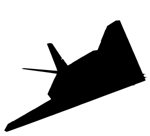
C-20

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	0	0.00	0	0.00	0	0	4,592
5 YR AVG	0.0	0.00	0.2	4.25	0.0	0.00	0.0	0.0	4,710.6
10 YR AVG	0.0	0.00	0.2	3.67	0.0	0.00	0.0	0.0	5,451.7
LIFETIME CY83-FY06	0	0.00	2	1.50	0	0.00	0	0	133,144



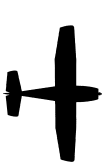
C-21

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	0	0.00	0	0.00	0	0	44,906
5 YR AVG	0.2	0.42	0.2	0.42	0.2	0.42	0.4	0.4	47,257.4
10 YR AVG	0.1	0.21	0.3	0.64	0.1	0.21	0.2	0.2	47,002.4
LIFETIME CY84-FY06	3	0.28	3	0.28	3	0.28	6	12	1,084,212



F-117

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	1	8.27	0	0.00	0	0	12,094
5 YR AVG	0.0	0.00	0.6	4.92	0.0	0.00	0.0	0.0	12,183.2
10 YR AVG	0.4	3.17	0.5	3.96	0.1	0.79	0.0	0.0	12,627.3
LIFETIME FY91-FY06	7	3.39	8	3.88	3	1.45	1	1	206,267

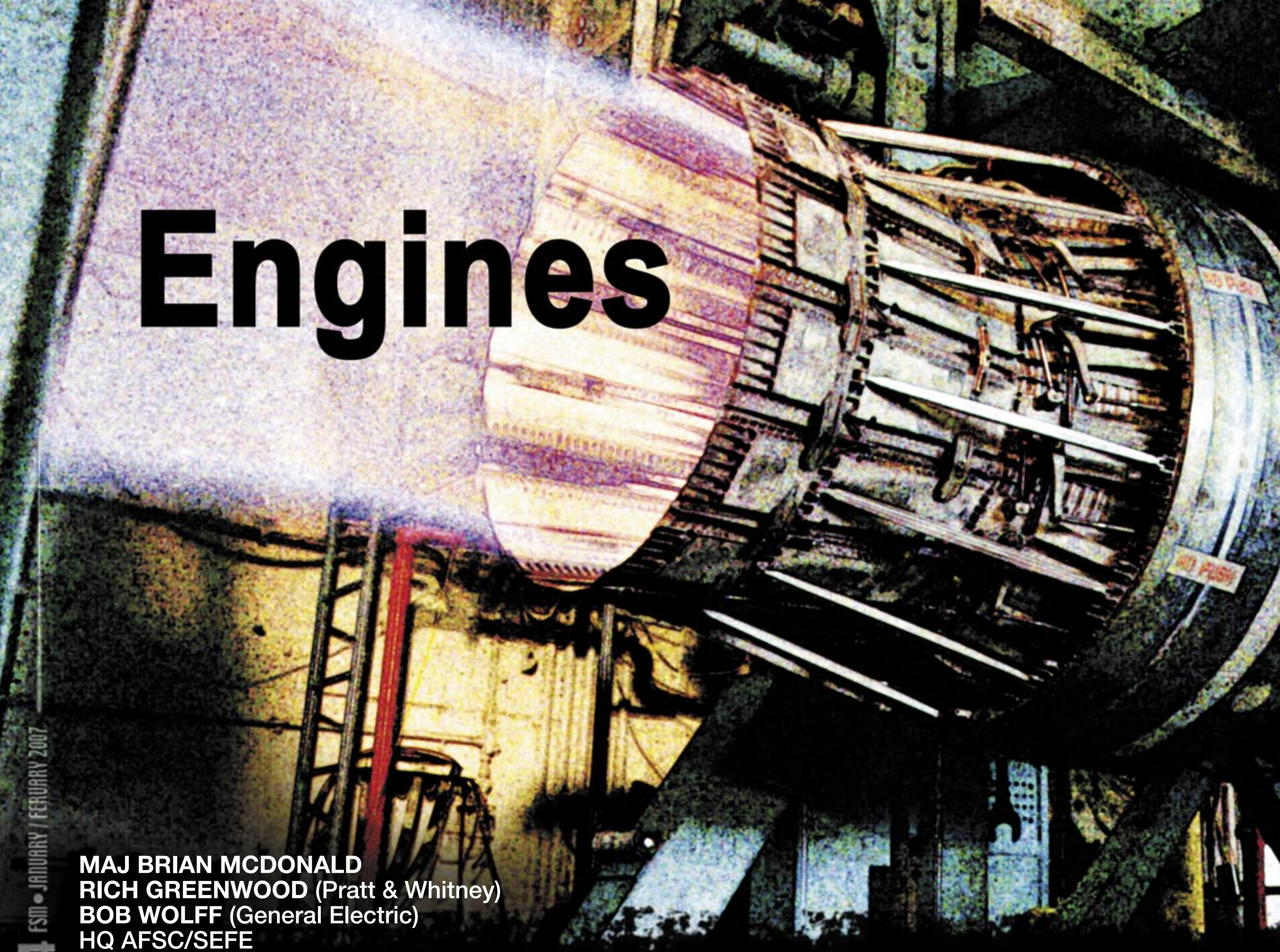


T-41

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY06	0	0.00	0	0.00	0	0.00	0	0	1,000
5 YR AVG	0	0.00	0	0.00	0	0.00	0	0	820
10 YR AVG	0	0.00	0	0.00	0	0.00	0	0	835
LIFETIME CY74-FY06	9	1.45	5	0.81	4	0.64	1	2	620,747

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

Engines



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

Fiscal year 2006 has been well publicized as a truly phenomenal year for Air Force aviation safety—all-time record lows in aviation-related fatalities, destroyed aircraft, and Class A mishaps. Adding to the historic nature of these achievements, the Air Force set a record low rate *and* total count in each of the three categories. As a subset of these overall FY06 statistics, propulsion safety did its part by keeping engine-related mishaps low. Thankfully, engine-related fatalities remained at zero for a second consecutive year. Class A mishaps caused by engine malfunction dropped again, this year to a total of five. The only upward trend, although minor, was in engine-related destroyed aircraft – three fighter aircraft were lost in FY06 versus two in FY05. As we do with each of our end-of-year articles, we will elaborate on each of the five Class A mishaps to promote greater awareness of our most costly propulsion safety issues.

Destroyed Aircraft

Not since June 5, 1998 had we lost an F-15 to a mechanical failure of one of its engines. On January 17, 2006, that streak *most likely* ended when an F-15C crashed into the Pacific Ocean fifty miles east of Kadena Air Base, Japan. Thirty minutes into the over-water training mission, the pilot heard a loud bang and felt the aircraft shudder. Multiple right engine overheat and fire warnings illuminated. His wingman visually confirmed the right-engine malfunction. Following emergency procedures, the pilot shut down the number-two engine. He began to notice the aircraft was tending to roll right so, he steadily corrected with increasing left stick to maintain level flight. When the pilot reached the limit of left stick, the aircraft rolled right and slightly nose down. To return to level flight, he added left rudder. When the aircraft rolled right again despite full left inputs, he realized the aircraft was uncontrollable and successfully ejected. Search and rescue forces subsequently recovered the pilot without serious injuries. The aircraft impacted in an area with an estimated water depth of 19,000 feet. Wreckage recovery was not attempted.

Because there was no hardware or data recorder information to confirm the failure mode, the Accident Investigation Board President was compelled to state he "… did not find clear and convincing ev-

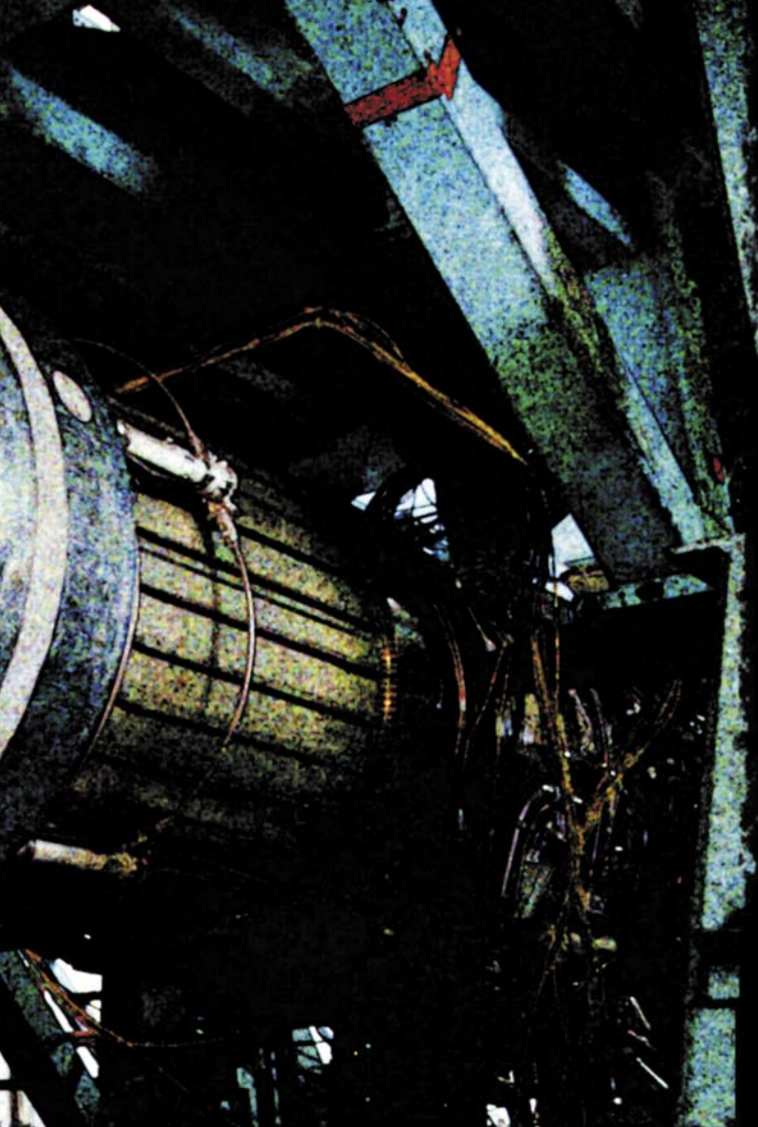


Photo Courtesy of Authors / Photo Illustration by Dan Harman

idence to determine the root cause of this mishap." Even to the casual observer, however, this sequence of events points to an uncontained engine failure that compromised the aircraft flight controls resulting in an unstoppable right roll.

Those close to the F-15 and/or F100 engine safety communities might be feeling a bit of déjà vu at this point. A mishap of amazing similarity occurred in May 2004 in which an F-15E out of Seymour Johnson AFB, NC ingested a large Black Vulture into its right engine. The ensuing sequence of events is nearly an identical match to the Kadena mishap and, therefore, is worth recapping to highlight this failure mode.

Shortly after the bird struck the engine, the aircraft began to roll right, which the pilot countered with left stick and rudder inputs and reduced left engine power. Following shutdown of the stricken right engine, the pilot momentarily relaxed aileron and rudder pressure. The aircraft made an uncommanded right roll to an inverted attitude, which the pilot allowed to continue until the aircraft returned to upright. At this point, he applied full left stick and rudder to maintain a slight right bank. The crew determined the aircraft was uncontrollable and successfully ejected.

By comparing this bird strike and its collateral damage to this year's mishap, the fan section becomes highly suspect. But, with 19,000 feet of water covering the evidence, only a few deep sea creatures may ever know the true cause! From the F100 engine community's standpoint, it is difficult to specifically remedy either one of these failures since the 2004 mishap exceeded the engine design specifications and the 2006 mishap was caused by an unknown failure. Therefore, corrective action will most likely come in the form of continued diligence in tracking and funding F100 fleet safety and reliability issues and partnering with the F-15 system program office and bird/animal strike hazard teams to address the other factors involved in these two mishaps.

The other two aircraft destroyed in FY06 by engine-related causes were F-16s. The General Electric- and Pratt & Whitney-powered fleets each took a hit to their statistics as the first was powered by the F110-GE-100 engine and the second was powered by the F100-PW-220 engine. We summarize them below, in chronological order, for your review and reflection.

Approximately one hour into a training mission, as the flight was preparing to leave the training range, the pilot received both auditory cues and cockpit indications of an engine compressor stall. The pilot jettisoned his stores, began an immediate climb, and attempted to clear the stall. The engine stall cleared, but the aircraft exhibited vibrations at all power settings and was unable to produce the thrust required to maintain level flight. When the pilot determined he could no longer maintain level flight, he initiated a turn toward dry land to avoid ejection over the waters of the Great Salt Lake. The pilot ejected over land, sustaining only minor scratches and bruises.

The ensuing teardown and technical analysis of the engine pointed to the cause of the mishap. Upon removal of the low-pressure turbine, the team of engineers from Tinker AFB and General Electric Aviation determined the number-four bearing had experienced surface-initiated fatigue and spallation. The condition of the bearing allowed the high-pressure spool to rotate eccentrically and close the blade clearances, resulting in interference between the rotor blades and adjacent shroud/liner. This, in turn, resulted in frictional heating of the blade tips to the point of metal transfer. Because of the damage to the bearing, the high-pressure turbine, and high-pressure compressor, the engine was no longer capable of producing adequate thrust to maintain level flight. As with most bearing related events, the violent release of energy destroyed the evidence needed to determine the root cause of the fatigue spallation.

This sequence of events has occurred in the past. The F110 engine community has implemented several actions to improve bearing debris detection and reduce the risk to the F110-powered fleet. These actions include:

- A change in the number-four bearing outer race material to one that is unique only to that bearing, which improves identification of bearing distress and subsequent troubleshooting.
- An improved oil flow path through which bearing chips can migrate to collectors for earlier detection of impending bearing failure.
- The widespread use of the Scanning Electron Microscope/Electron Dispersion X-Ray (SEM/EDX) to accurately measure and identify composition of material found on the master chip detector.

Although the engine involved in this mishap had already incorporated these improvements, the threshold of bearing debris in use at the time of the mishap did not require removal of the engine.

Additional design improvements are coming online as part of the Service Life Extension Program. These include a redesigned high-pressure rotor with a stiffened aft shaft for increased critical speed margin, and a new, stronger nitrided M50 bearing. Until all design changes are in place, meticulous post-flight visual inspection of the master chip detector, combined with SEM/EDX monitoring, is our front line defense against number four bearing failures. Use of the SEM/EDX system has been instrumental in detecting the progression of fatigue spallation before the originating surface condition is obliterated. This has allowed for isolating the root causes of number-four bearing events, and taking preventive actions specific to those root causes; i.e., assembly damage, contamination and others.

The F110 engine community is also conducting a thorough investigation of other recent number-four bearings events. Initial findings indicate assembly damage during field installation has been a significant contributor to the recent occurrences. This experience is consistent with historical maintenance campaigns where the number-four bearing area has been disturbed. As a result, the community has initiated a review of number-four bearing assembly procedures, gathered best practices from other engine lines, and is aggressively implementing improved assembly procedures in the field and at the depot.

The last of the three engine-related destroyed aircraft crashed about three miles southwest of Luke AFB, AZ. It was part of a Basic Fighter Maneuvers training mission. The flight performed an afterburner formation takeoff. Shortly after gear retraction, the pilot advanced the throttle to maximum afterburner, then retarded it back to idle to maintain proper formation. When the throttle reached idle power, he heard a bang and felt the aircraft shudder. The flight lead saw fire coming out of the engine nozzle. After initiating a maneuver back towards Luke AFB, the pilot realized the engine was unresponsive and no longer producing thrust. Due to the low altitude, the aircraft had insufficient energy to make it back to the runway. After rolling wings level, the pilot successfully ejected. The aircraft impacted a corn field and was destroyed.

Data recovered from the crash-survivable flight data recorder and the Digital Electronic Engine Control (DEEC) revealed a fault associated with the Rear Compressor Variable Vane (RCVV) system that caused the DEEC to transfer the engine from primary control mode to secondary control mode, just as the throttle was being moved from afterburner to idle. Because of differences in the fuel flow schedule between primary and secondary modes, the engine is susceptible to a stall when a control mode transfer is made during a throttle transient. This condition was amplified by the fact that the throttle transient spanned the entire power range. The engine stall intensified into a stagnation because secondary control lacks the stall recovery logic afforded by the DEEC when operating in primary mode. Recovery from engine stagnation in secondary mode requires the pilot to bring the throttle to cut-off and affect a restart. Due to the low altitude of the event, the pilot was unable to clear the stagnation. Mishap damage prevented conclusive determination as to the cause of the RCVV system fault. The Accident Investigation Board identified the most probable source of the malfunction to be the RCVV electro-hydraulic servo valve.

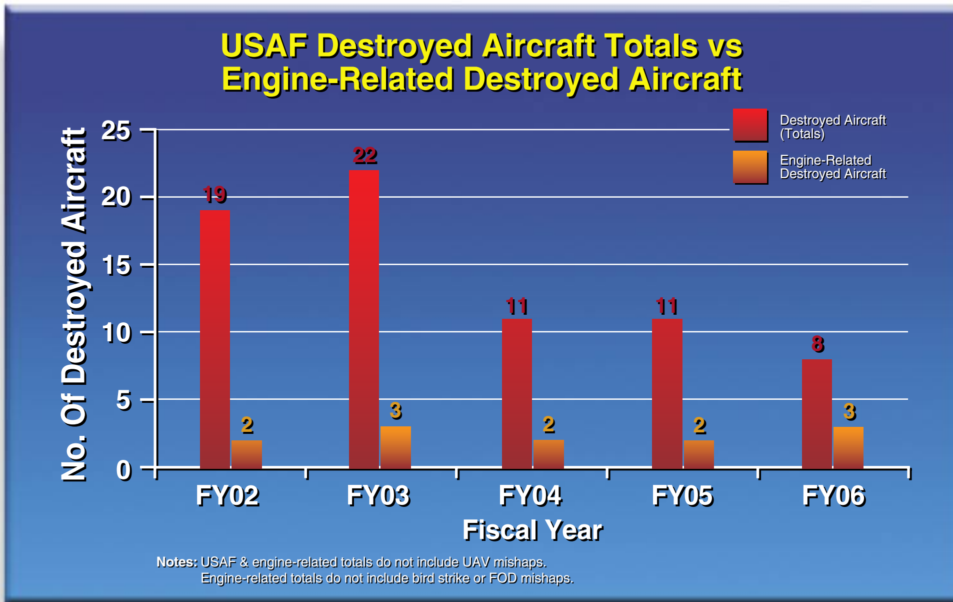
As you can see in this mishap, three events that are independently innocuous combined to create a mishap chain of events that destroyed a twenty-one million dollar aircraft:

1. A rapid throttle chop
2. A fault resulting in a transfer to secondary control mode, and
3. An altitude too low to allow for a restart

Many mishaps are the result of the improbable. To gain a better appreciation of the risk of control transfer and to prevent future occurrences, the F100 engine community is now tracking "near-miss" transfers from primary to secondary mode that will trigger preventative maintenance actions.

To show these three destroyed aircraft in the context of the last five years, we present Figure 1. The two bars for each fiscal year represent the total number of destroyed aircraft (left) and the number of engine-related destroyed aircraft as a subset of the total (right). Engine-related loss of aircraft has remained steady at two or three per year while the overall total has dropped dramatically over the depicted five-year timespan. An encouraging change from FY04 and FY05 was the absence of operations and maintenance-induced engine failures this year. Now, the engineers are really feeling the pressure to improve!

Figure 1



More Fighter Facts

Since the only engine-related Class A flight mishaps for the entire fighter/attack fleet were these three destroyed aircraft, we will finish our year-end review of the F-15 and F-16 here before moving on to the two Class A mishaps recorded by the mobility fleet.

F-15

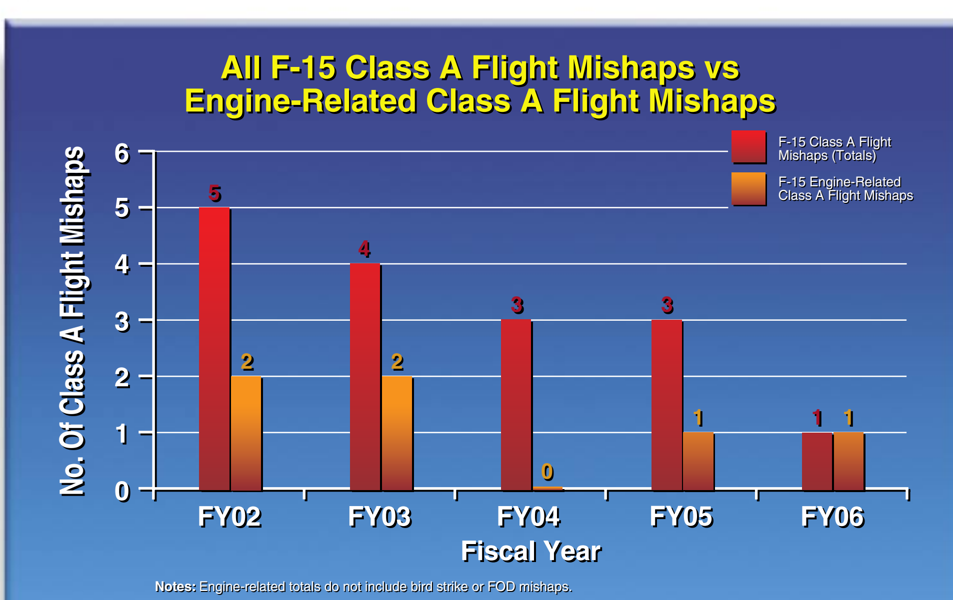
In terms of statistical deviation, the F-15 was the attention grabber this year due to recording its first mark on the engine-related destroyed aircraft table after seven-and-a-half years. Table 1 provides a three-year snapshot of all variants of the F100 engine currently flying in the F-15. This year it was a -220 model.

Table 1

F-15 Engine-Related Destroyed Aircraft Statistics						
Fiscal Year	FY04		FY05		FY06	
Engine	Aircraft Losses	FY04 Rate	Aircraft Losses	FY05 Rate	Aircraft Losses	FY06 Rate
F100-PW-100	0	0.00	0	0.00	0	0.00
F100-PW-220	0	0.00	0	0.00	1	0.60
F100-PW-229	0	0.00	0	0.00	0	0.00
All Engines	0	0.00	0	0.00	1	0.32

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

Figure 2



If we then add in all the other F-15 Class A flight mishaps that occurred in FY06, nothing changes—there were no others! Figure 2 expands on Table 1 by including engine-related, dollar-cost Class A flight mishaps in addition to destroyed aircraft. As you can see in Figure 2, a single Class A flight mishap should be viewed as a banner year for the F-15. Perfection on this chart was only one engine-related loss of aircraft away.

Table 2

F-16 Engine-Related Destroyed Aircraft Statistics						
Fiscal Year	FY04		FY05		FY06	
Engine	Aircraft Losses	FY04 Rate	Aircraft Losses	FY05 Rate	Aircraft Losses	FY06 Rate
F100-PW-220	0	0.00	0	0.00	1	0.94
F100-PW-229	0	0.00	0	0.00	0	0.00
F110-GE-100	0	0.00	1	0.73	1	0.68
F110-GE-129	0	0.00	1	2.19	0	0.00
All Engines	0	0.00	2	0.63	2	0.62

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

F-16

Following a terrible FY01, during which we lost seven F-16s due to engine malfunctions, the last five years have stabilized at about two losses per year. FY06 reinforced that average. Table 2 conveys this point in a numeric format, including associated rates. Table 2 and Figure 3 show that we are now two years removed from having achieved our airframe-specific goal of zero engine-related destroyed F-16s. Knowing that F-16 losses have traditionally dominated this category, FY04 should boost our resolve to achieve a broader goal—zero engine-related destroyed aircraft of any type! Be an expert, be dedicated, be vigilant!

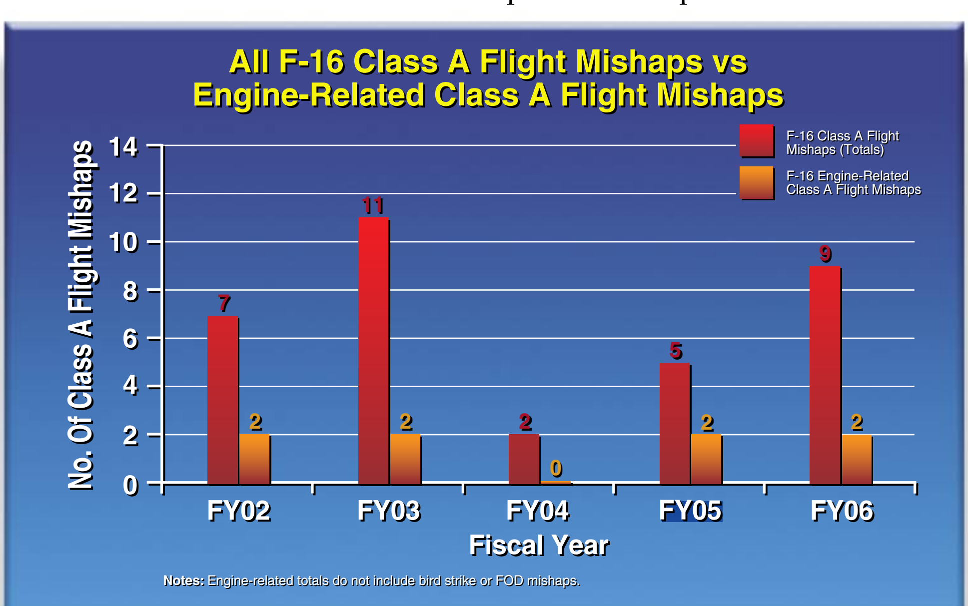
Class A Flight Mishaps

The story is short here as well. To reiterate the introductory paragraph, there was a total of five engine-related Class A flight mishaps in FY05. Three of the five mishaps have already been described. The remaining two were dollar-cost Class A mishaps, one involving a C-17 airlifter and one involving a KC-10 tanker. Although engine maintenance was not causal in any FY06 fighter Class A, it was in one of the mobility Class As. The C-17 mishap described below reinforces the need for clear technical orders, adherence to those technical orders, and appropriate inspection of work. At the time of this writing, the KC-10 mishap was still under investigation, so the description is brief.

F117-PW-100 (C-17)

During climb out after a go-around, the crew heard a loud bang and saw indications of a number-four engine failure on the warning annunciator panel. Flames were confirmed emanating from the core of the number-four engine. Both fire bottles were used to extinguish the flames, an in-flight emergency declared, and a successful three-engine landing performed. Subsequent borescope of the engine showed extensive damage to the high-pressure compressor section.

Figure 3



Disassembly of the engine found that one of the variable inlet guide vanes was not connected to its synchronizing ring. This resulted in that vane not being properly positioned during engine operation. One vane out of position in relation to the others results in an aerodynamic "bumping" of the downstage compressor blades as they pass behind the one incorrectly positioned vane. This repeated, high-frequency strumming of the downstream blades eventually leads to fatigue cracking and failure of one or more blades. In this case, six blades in the seventh-stage fractured, resulting in extensive damage to all downstream hardware and a non-recoverable in-flight shutdown. As a result of this mishap, enhanced inspection procedures were put in place at all F117-PW-100 core maintenance facilities to preclude installation errors of the variable vane system.

F103-GE-101 (KC-10)

On initial takeoff roll, the crew received indication that the number three (right) engine had rolled back. In accordance with flight manual procedures, the takeoff was aborted and the engine was shut down. A borescope inspection revealed internal damage to the engine. At the time of this writing, the safety investigation for this mishap was ongoing.

Now that we have summarized all FY06 engine-related Class A flight mishaps, we examine Figure 4 to see what the trend has been over the past five years in this category. The downward trend in engine-related Class A flight mishaps over the past three years, from a high of twelve in FY04, has brought us back in line with the fives we recorded in FY02 and FY03. Other than a small spike in FY05, the overall USAF Class A flight mishap annual totals have consistently dropped, resulting in engine-related mishaps accounting for a larger portion of the total—28 percent for FY06. Overall, the graphic is a positive.

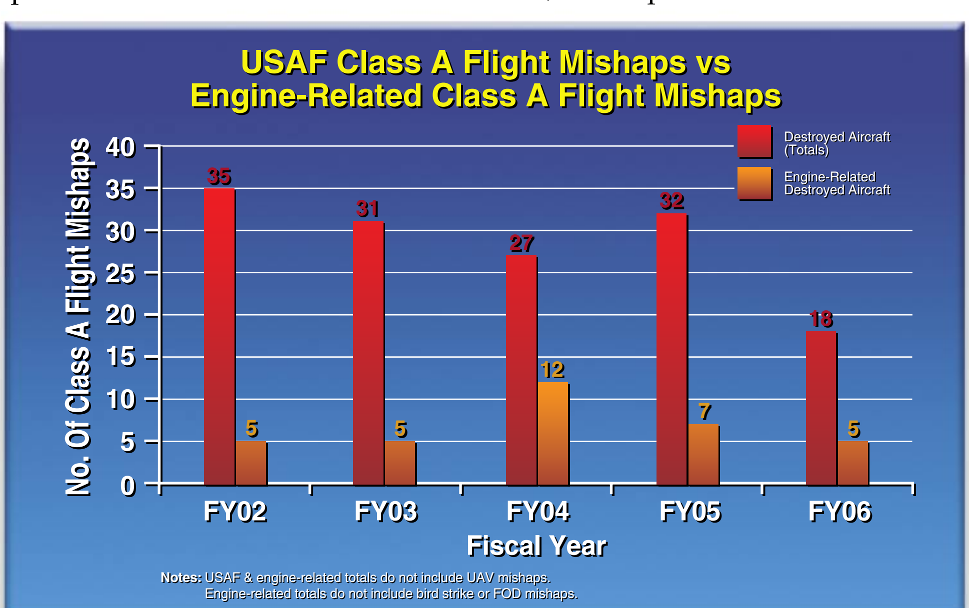
Attention All Investigating Officers

Our new AF/SE, Maj Gen Gorenc, has placed renewed emphasis on timely engine-related mishap investigations of high quality. He is concerned by average timelines well beyond established goals, a significant percentage of reports of questionable quality, and investigating officer ignorance of their exhibits' status. We know that a 30- or 60-day engine investigation, which thoroughly explains the cause of the mishap with focused, practical recommendations, requires constant communication between the investigator and the assigned equipment specialist. When exhibits must be shipped to a repair facility for teardown and analysis, make the USAF Deficiency Reporting (DR) and Investigating System (TO 00-35D-54) work for you. Do this by completing the following checklist:

- DR annotated as Mishap/High Accident Potential (MHAP)
- Mishap number (AFSAS 6-digit) entered on DR
- Investigating Officer (IO) name and contact information entered on DR
- Positive voice and/or e-mail contact made with individual assigned to analyze exhibit
- Mishap summary and evidence collected-to-date relayed to individual analyzing exhibit
- Frequent status updates requested and received from repair facility
- Exhibit teardown report received and understood

Furthermore, we strongly encourage your attendance at the teardown. These actions will heighten the awareness of all involved and, inevitably, improve both timeliness and quality of your engine investigation. Ultimately, you, the safety investigator, are responsible!

Figure 4



Farewell...

Mr. Bill Bradford, a long time author of the "Engines" article, retired from the Air Force Safety Center on January 3, 2007 after thirty-two years of civil service. Bill's work in safety dates back to 1984 when the Air Force Inspection and Safety Center resided at Norton AFB, CA. He has been a major force in pushing engine safety to the forefront and in helping to drive down propulsion mishap rates to the lows we see today. The authors (a.k.a. "Team Engine") thank Bill for his service and friendship. Our best wishes for an enjoyable, and well-deserved, retirement!

USAF CLASS A FLIGHT MISHAPS

FY07 Aviation Mishaps
(Oct 06 - Jan 07)

4 Class A Mishaps (4 Flight)
1 Fatalities
2 Aircraft Destroyed

FY06 Aviation Mishaps
(Oct 05 - Jan 06)

11 Class A Mishaps (7 Flight)
0 Fatalities
2 Aircraft Destroyed

02 Oct	✈	A C-21 departed runway near approach end and caught fire.
02 Oct		An F-15E had multiple bird strikes; damage to # 2 engine and left wing.
26 Oct		An F-16C caught fire during AB takeoff; pilot aborted.
27 Nov	✈	An F-16C CFIT (IAW CSAF guidance; currently a non-reportable loss under DoDI 6055.7)
04 Dec	✈	An F-16D experienced engine failure.

- 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 all fatalities associated with USAF Aviation category mishaps.
- "✈" Denotes a destroyed aircraft.
- "✶" Denotes a Class A mishap that is not in the "Flight" category. Other Aviation categories are "Aircraft Flight-Related," "Unmanned Aerial Vehicle," and "Aircraft Ground Operations."
- Air Force safety statistics are updated frequently and may be viewed at the following web address: http://afsafety.af.mil/stats/f_stats.asp
- **Data includes only mishaps that have been finalized as of 02 Feb 07**.

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