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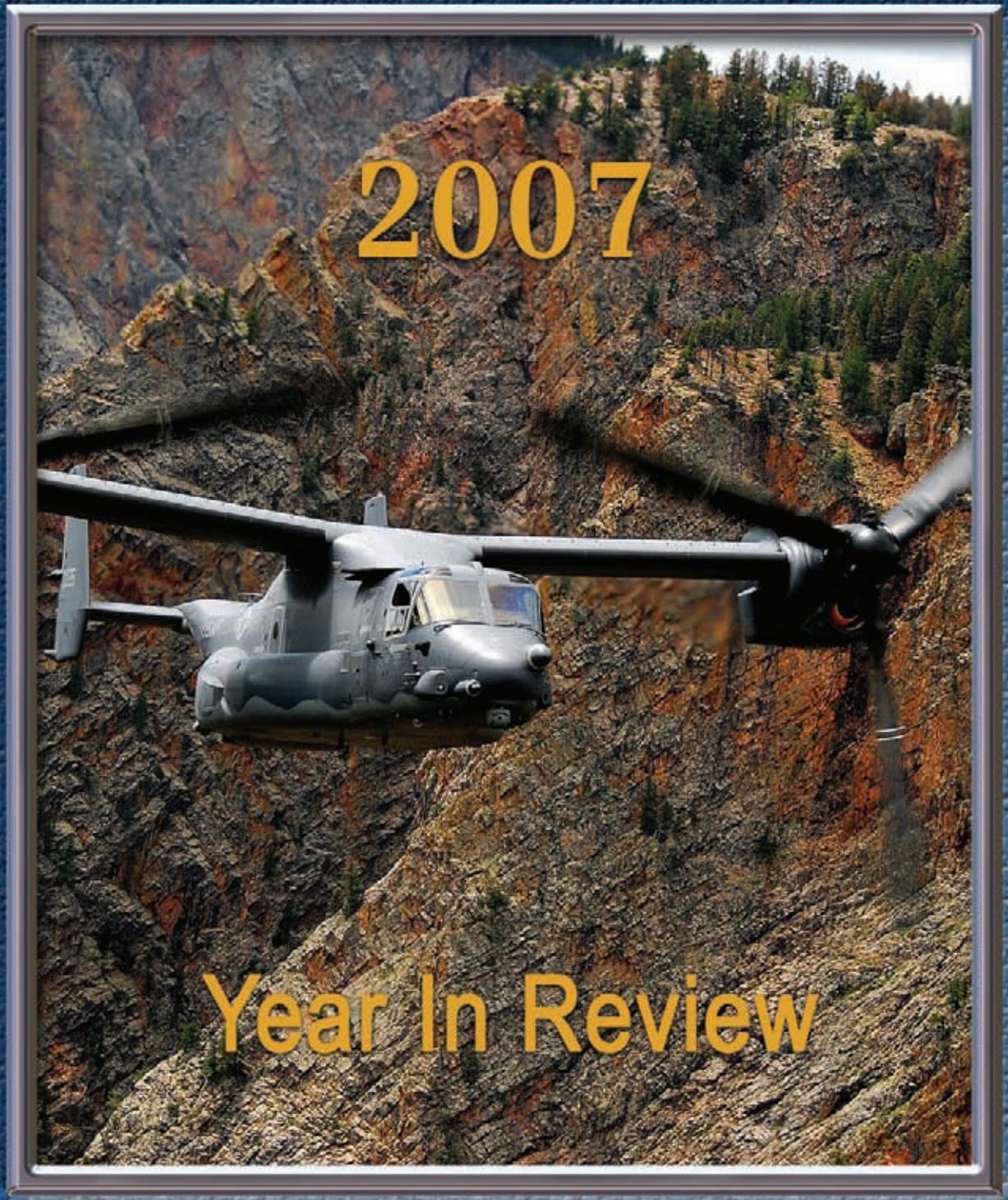

2007

Year In Review

FSM
FLYING SAFETY MAGAZINE
AIR FORCE RECURRING PUBLICATION 91-1

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U.S. AIR FORCE

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HQ AFSC Photo

Major General Wendell L. Griffin, USAF
Chief of Safety

I congratulate all Airmen for logging another successful year in aviation safety.

After setting the record in fiscal year 2006 for the safest flying year in history, the U.S. Air Force came up a little short of matching that accomplishment in FY07. The Air Force experienced 27 Class A aviation flight mishaps and 14 destroyed aircraft, up from 19 Class A mishaps and eight destroyed aircraft last year. There were setbacks in a few weapon systems and significant safety progress in others, with the overall FY07 mishap rate coming in just below the 10-year average.

I know we can do even better this year. Our outstanding performance in FY06 shows we have the capability to improve risk management in both operations and maintenance in order to eclipse our FY06 record through appropriate vigilance by our commanders and Airmen. We identified two major trends for FY07 — human error and engines — and I believe we can turn those trends around.

That is my charge to all Airmen. Let's combat those trends through leadership, awareness and training. Safety is critical for efficient and successful military operations. Loss of Airmen, aircraft, or resources through mishaps degrades our combat capabilities just as deeply as losses to enemy action.

Our commanders are the backbone and leaders for our ultimate success in this area. At Air Force Safety, we promise to do all we can to provide every commander the training, tools and capabilities they need to manage risk and institutionalize improvements in their safety programs. We ask that commanders ensure safety is centered on their radar scope and ingrained in daily operations.

All Airmen understand that wingmen must cover others' 6 o'clock in both war and peace. Good wingmen never go off duty, and they willingly support leaders, subordinates and peers in protecting our Air Force people and resources. Reinforcing this wingman heritage with every Airman will help our efforts in mishap prevention.

Let's continue doing business smartly and avoid preventable mishaps. We're on the right track. I challenge every commander and Airman to keep safety integral to mission accomplishment and make FY08 a new record year for aviation safety. ★★

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BASH

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USAF Photo

FY07 Class A Mishaps

The Air Force experienced a marked increase in the number of BASH-related Class A mishaps in FY07. From FYs 73-06, the total number of BASH-related Class A mishaps was 41, an average of 1.2/year. In 2007 alone, there were 6 Class A mishaps involving birds, with a total damage cost of $15,882,864, averaging $2,647,144 per mishap. Five out of the six mishaps involved bird ingestion, and one mishap involved birds destroying the canopy, sending FOD into both engines. Fortunately, no fatalities or serious injuries occurred; however, one aircraft was completely destroyed.

On 2 October 2006, an F-15E on a training mission from Seymour Johnson AFB experienced a bird strike at 3,000 ft AGL. The mission profile called for a low-level navigation route using Terrain Following Radar, followed by surface attack events. Since both the Bird Avoidance Model (BAM) and Avian Hazard Advisory System (AHAS) bird activity forecast models listed a Low risk, the flight selected VR-073 from points B to F as their route of flight to R-5314. Using AHAS, the Mishap Flight (MF) checked bird conditions along the route of flight prior to stepping to the aircraft and at the end

of runway prior to departure. On both occasions, the forecast risk level was Low from points A to C, and Moderate from C to F. Due to heavy bird activity, the 4 OG established a permanent minimum altitude between VR-073 points E and F. The MF announced a climb to 3,000 ft AGL from 1,500 ft AGL IAW 4 OG BASH restrictions. At 20:18:53L, a bird strike occurred approximately 64 miles northeast of Seymour Johnson AFB at 3,080 ft radar altitude at a speed of 395 KCAS. The MF returned safely to Seymour Johnson AFB after performing appropriate emergency procedures.

Several bags of remains were sent to the Smithsonian Institution Feather Lab for identification. Both feather and DNA analysis identified the species struck as a Great Blue Heron (4.6 – 5.5 lbs). Further DNA analysis indicated that multiple Great Blue Herons were involved in this strike. According to the Smithsonian, this was the 2nd highest (3,080') Great Blue Heron strike ever recorded.

Radar studies show that on average 50% of nocturnal migrants, most of which are small birds, travel below 1,312 - 2,296 ft and 90% below 4,921 - 6,561 ft. However, radar studies also show that birds do migrate regularly, although to a minimal extent, at much higher altitudes. Some species of birds have been recorded migrating at over 19,000 ft (Alerstam 1990).

On 26 December 2006, a C-5B out of Dover AFB struck a flock of 11 Snow Geese (5-7 lbs) one minute into the flight at an altitude of 800 - 1,000 ft. Post flight inspection of the MA revealed the numbers 2 and 4 engines had sustained damage. Nine Snow Geese struck the left and right wings and nose cone, but no additional damage occurred.

Dover AFB is located just west of Delaware Bay. The Bay area is a wintering location for several species of birds including Snow Geese. The base is surrounded by agricultural areas that contain crops highly attractive to the large over-wintering bird population. In addition, three wildlife areas are located just east of the base: Bombay Hook National Wildlife Refuge, Little Creek Wildlife Area, and the Harvey Conservation Area. All three areas lie within eight miles of Dover AFB with the closest less than three miles. Snow Geese can be found in all three areas during migration and the winter season.

During this time of year, bird watch conditions (BWC) change throughout the day depending on bird activity. The BWC changed seven times to Moderate or Severe in just one hour prior to the mishap. Beginning at sunrise, large flocks of geese make daily feeding flights west in search of food which routinely takes them over Dover's airfield and subsequently through the approach and departure corridors. Throughout the day, smaller flocks filter through the airspace from the west as geese return from feeding.

On 18 January 2007 at 1329L, a T-38C on a training mission from Columbus AFB struck multiple ducks (Mallards, 3-4 lbs) shattering the front cockpit canopy sending canopy fragments into the engine inlets. The MA was unable to maintain altitude due to inadequate engine performance while in the low-level environment, and both pilots safely ejected. The mishap occurred in the Mississippi Migratory Flyway and at a location where several species of waterfowl over-winter. According to the Columbus AFB BASH Plan, the BWC is set at Phase II from September through April due to the over-wintering birds in the area. The increase in bird populations during the winter months substantially increases the risk of bird strikes for low-level flights. This population increase was reflected in AHAS where the first leg of the route was Severe (Phase II) and Moderate throughout the remainder of the route. While on the first leg, pilots observed "thousands" of birds below them. Five minutes after passing the end of the "Severe" route leg, the MA descended down to 600-800 ft AGL. Thirteen minutes later, Mallards shattered the canopy.

On 21 March 2007, an F-15E deployed to the OEF AOR ingested a Black Kite (1.5 – 2.2 lbs) on final approach one quarter mile short of the runway at 100 ft AGL. The MP continued with the critical phase of the flight and successfully landed the MA.

Many migratory flyways transit through the mountains in the OEF Theater. This particular base is located on a migratory bird route used by two large bird species: Black Kites and Asian Cranes. Black Kites (raptor family) are attracted to the pre-existing landfill located within 1,500 ft of the departure end of the runway.

On 20 June 2007, a KC-135R on a training exercise in Australia struck an Australian Pelican (9.24 - 14.96 lbs) on final approach to Brisbane International Airport, Queensland, Australia. At approximately 100 ft AGL, a single pelican was ingested into the number 1 engine, causing it to seize. The MP successfully landed the aircraft.

On 14 September 2007, an F-15E sustained significant bird strike damage at 1147L while performing acrobatic maneuvers during a demonstration flight in the vicinity of Brunswick NAS, Maine. Bird remains were sent to the Smithsonian for identification. Results indicate that the MA struck and ingested a Common Loon (5.5-13.4 lbs). The crew was able to safely land the aircraft.

Lessons Learned

It is difficult to explain exactly why the number of Class A BASH mishaps increased from an average of 1.2/year over the past 33 years to 6 in FY07. Besides the biological aspect (birds and habitat), one needs to analyze and compare such variables as the number of flights, number of low-level

flights, time of flights, weather, climate change, etc. from year to year. Human error, including but not limited to improper risk management, could also be a causal factor leading to the increase in bird strikes.

Evolution has fined-tuned species to survive and proliferate in their environment. Bird migration, wintering areas, and nesting regions are selected by evolution to enhance fitness (passing on of DNA) and are predictable from year to year. Based on these three constants, along with seasonal agricultural practices in the local area, the Air Force established Phase I and Phase II periods of bird activity in addition to the normal BWC. Both pilots and flight planners need to understand the possible implications of the Phase II period to flight safety and how to incorporate the Phase II period in their risk assessment (AFPAM 91-212: 2.5.4.6). Low-level flights are especially vulnerable to bird strikes, especially during the Phase II period. An essential step in planning a low-level route should involve the use of BAM and AHAS. The optimal value of BAM and AHAS can only be attained if pilots and planners understand, utilize, and evaluate system output in addition to following AF and/or unit instructions.

Bird watch condition codes are current conditions on the airfield and can be a valuable tool for supervisors to make operational changes. Visual inspection of the airfield by operations and airfield control personnel is the basis for setting a BWC. AHAS should not be used to set BWC on an airfield; birds loafing or feeding and mammals on the airfield will not be detected by radar. The mobility of birds warrants the need to set the entire airfield to the same BWC; if wildlife activity on a runway causes the BWC to be Severe, the entire airfield should be Severe. One constant that can always be planned for is that wildlife activity will always increase around sunrise and sunset, so unless it is absolutely necessary, flying one hour before and after sunrise and sunset should be avoided.

Land-use practices and habitats are key factors determining the wildlife species and size of wildlife populations attracted to an airfield. The most effective BASH plans will recognize and control those land-use practices and habitats on and near the airfield which are attractive to hazardous species.

It is well documented that landfills attract and provide food to several avian species hazardous to aviation. If feasible, landfills should either be closed or moved as far away from the airfield as possible. Any landfill located within five miles of an airbase should take steps to deter hazardous species from using their landfill. Landfill operations staff must assure that all putrescible waste is properly buried or incinerated along with maintaining an active bird control program; an active bird control program may entail the use of pyrotechnics, lethal control (shooting or trapping), and effigies.

In terms of BASH, all airfields are unique in habitat, wildlife species, hazard mitigation measures taken, and land-use surrounding the airfield. Flying into an unknown region or airfield can be a risky endeavor, putting both aircrew and aircraft at risk. Prior to aircraft using an airfield, an Advanced Echelon team should be sent to the location to access the wildlife hazard risk.

Wildlife activity on an airfield can change seasonally, monthly, daily, hourly, and even by the minute. A tool such as AHAS does not make recommendations on the flight restrictions imposed by any category of wildlife risk. As stated in AFPAM 91-212, these decisions should be made at the local level based on airframe, nature of the mission, and mission priority. Even after making all the right decisions, following proper procedures and regulations, wildlife strikes are going to occur. Our collective goal is to eliminate loss of life and reduce asset damage while sustaining military readiness.

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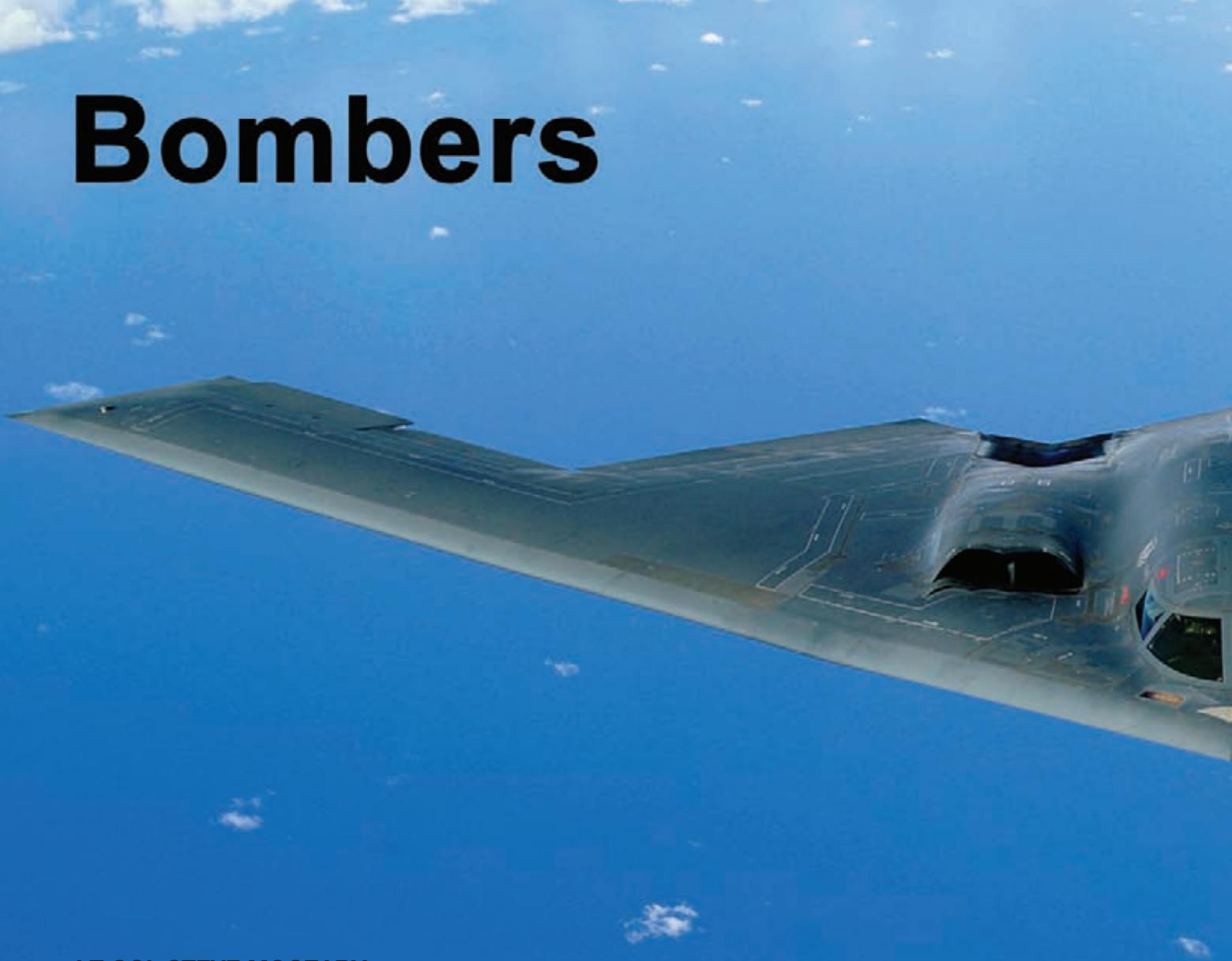
USAF Photo

Bombers



LT COL STEVE MOCZARY
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As most of you already know, FY07 was an average year for Air Force Class A flight mishaps. Looking back at the last 10 years (FYs 97-06) the Air Force managed a middle-of-the-pack finish for our FY07 (1.28) Class A flight mishap rate. The Air Force had better rates in FY06 (.9), FY00 (1.13), FY98 (1.14), FY01 (1.16) and FY04 (1.18); while FY03 (1.29), FY97 (1.42), FY02 (1.47), FY05 (1.49), and FY99 (1.6) had worse rates than FY07.

Our troublesome trend was identified in the May 07 *Flying Safety Magazine* article by Col Brandt (AFSC/SEF) on page 7, and the July 07 FSM article by Maj Gen Griffin (AF/SE) on page 4. Fortunately, our middle-of-the-pack Class A flight mishap rate did not translate into middle-of-the-pack results for other measures of performance. The destroyed aircraft rate for FY07 placed 4th (.69) which tied with FY00, and for aviation-related fatalities, FY07 placed 2nd (.10) with third place going to FY00 (.34).

So how did the bomber community do? I am pleased to report we did a fair amount better than the rest of the Air Force. The B-2 improved its Class B rate over FY06, tied with its FY06 Class A, Destroyed, Fatality, and Class C rate. The B-52 improved its Class C rate over FY06, tied with its FY06 Class A, Destroyed, and Fatality rate, but had an increase in its Class B rate. Lastly, the B-1 improved its Class A and C rate, tied its Destroyed and Fatality rates, but increased its Class B rate.

In summary, for FY07, the B-2 had a slightly better year than the B-52 with the primary differentiator being the B-2 Class B mishap rate of zero versus 25.47 for the B-52. The B-1 placed third with a non-zero Class A rate and a Class B rate nearly 2.5 times greater than that of the B-52. If you look at FY06, and the 5- and 10-year averages, the standings remain static with B-2 maintaining the lowest Class A rate, the B-52 maintaining the lowest Class B rate, and the B-1 with higher rates than the other two in nearly every category.

USAF Photo by SSgt Bennie J. Davis, III

B-2

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	0	0.00	0	00.00	0	0.00	0	0	7,629
5 YR AVG	0	0.00	1	17.13	0	0.00	0	0	7,005
10 YR AVG	0	0.00	1	13.17	0	0.00	0	0	6,074
LIFETIME FY90-FY07	0	0.00	8	11.08	0	0.00	0	0	72,224

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

FY07 B-2A (Spirit)

FY07 B-2 Class C mishaps tied with FY06 for a total of two. Class E events increased with 59 reported for FY07 versus 56 reported for FY06.

Class C Mishaps

The B-2 community only had two: a right main landing gear trunnion cracked, and a deteriorating tile departed the aircraft.

Class E Events

With the exception of 58 BASH events, the B-2 had one additional propulsion event due to an engine number 2 malfunction and subsequent in-flight shutdown.

USAF Photo

B-52

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	0	0.00	4	20.38	0	0.00	0	0	19,629
5 YR AVG	0.2	0.83	2.6	10.85	0.0	0.00	0.0	0.0	23,969.2
10 YR AVG	0.1	0.41	2.4	9.93	0.0	0.00	0.0	0.0	24,162.4
LIFETIME CY55-FY07	98	1.27	188	2.45	76	0.99	99	315	7,689,043

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

FY07 B-52H (BUFF/Stratofortress)

Additionally for FY07, Class C mishaps improved with 9 for FY07 versus 15 for FY06. Class E events increased with 172 reported for FY07 versus 151 reported for FY06.

Class B Mishaps

Of the 5 B-52 Class B mishaps, 3 were due to powerplants with no commonality. The first was due to the number 1 engine having an out-of-limits EGT, the second was a number 2 bearing failure on the number 1 engine, and the third was a known failure mode of a first stage turbine blade in the number 5 engine. The fourth Class B was an engine number 3 fire due to a failed hydraulic supply hose, and the fifth Class B was a bird strike to the number 6 engine.

Class C Mishaps

There were 9 B-52 Class C mishaps. In order of occurrence, they were FOD in the number 6 engine, a bird strike on the radome, gearbox failure on the number 7 engine, auxiliary air door compartment self-locking nut ingested in the number 2 engine, brake fire on the number 3 wheel, engine cowling rivet head ingested in the number 6 engine, bird strike on the radome, dual wingtip static discharge, and a number 5 fuel manifold failure. No trends were identifiable from this data set.

Class E Events

Out of the 189 B-52 Class E events, 130 were BASH, 23 were propulsion (engine number 3 had 7, engine number 5 had 6, engine number 7 had 4, engine number 6 had 3, engine number 1 had 2, and engine number 8 had 1), seven were miscellaneous (5 smoke and fumes; 2 IFR doors), 6 were physiological (3 due to pressurization, 2 sinus blockages, 1 abdominal pain), 4 were HAPs (3 fuel starvation flameouts, 1 fuselage FOD), 3 were flight controls (uncommanded roll/turn), and there was 1 each for CMAV (runway intrusion) and HATR (improper ARTCC clearance). From the 127 BASH events, we concluded that having 8 engines hanging from a 185-foot wingspan with a frontal cross section the size of several barn doors provides ample opportunity to smack helpless birds out of the sky.

USAF Photo by MSgt Robert W. Valenca

B-1

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	1	4.03	13	52.36	0	0.00	0	0	24,830
5 YR AVG	1.8	7.85	10.0	43.59	0.0	0.00	0.0	0.0	22,942.2
10 YR AVG	1.1	4.65	7.1	29.98	0.2	0.84	0.0	0.0	23,680.0
LIFETIME CY84-FY07	22	4.31	86	16.87	7	1.37	6	11	509,916

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

FY07 B-1B (Bone/Lancer)

The B-1 FY07 Class C mishaps improved with 17 versus 29 for FY06. Class E events increased with 110 reported for FY07 versus 81 reported for FY06.

Class A Mishaps

There was only one B-1 Class A on 26 Aug 07 when a deployed B-1 landed with a number 4 engine fire. The investigation is ongoing.

Class B Mishaps

There were 15 B-1 Class B mishaps. Chronologically they were: number 4 in-flight shutdown (IFSD) due to liberated fan blade, aborted takeoff due to liberated fan blade tip shroud, number 4 engine non-recoverable IFSD (NRIFSD) due to an uncontained LPT failure, number 2 engine NRIFSD due to CSD failure, number 2 engine NRIFSD due to liberated LPT blade, number 3 engine IFSD, right side number 1 spoiler damaged due to failed hinge, brake fire due to aborted takeoff, left number 1 spoiler damaged in-flight, FOD in the number 4 engine, number 4 engine LPT blade liberated in-flight, bird strike damage to number 7 flap, number 2 engine damaged due to failed MLG tire, number 3 engine damaged due to failed MLG tire, KC-135 boom, and B-1 slipway damaged. Based on these results, the B-1 should only fly with the number 1 engine; it appears impervious to malfunction.

Class C Mishaps

The Bone had 16 Class C mishaps. They were, in chronological order: number 2 engine ingested multiple aircraft fasteners on landing, number 2 engine ingested fastener during flight, left MLG door actuator rod failed, number 2 engine ingested two jo-bolts, number 4 engine inlet bird strike damage, FOD in the number 3 engine, landing light ingested into the numbers 3 and 4 engines, number 1 engine damaged from shifting IGV shroud, number 1 engine damaged from bearing failure, ice ingested and subsequent FOD in the number 3 engine, number 2 hydraulic system failure, FOD in the number 3 engine from unknown object, lightning strike to tail, FOD in the number 3 engine from fastener, bird strike left aft wing glove and blown tire damage.

Class E Events

The B-1 community had 111 events: 62 were BASH, 2 HAPs (control stick breakage, improper Forward Weapons Bay, Stores Bay Tank installation), 1 HATR (vehicle failed to yield on taxiway), 3 miscellaneous (2 fumes in cockpit, 1 tail lightning strike), 1 physiological (fumes in cockpit), and 42 propulsion (14 related to number 1 engine, 7 related to number 2 engine, 10 related to number 3 engine, 11 related to number 4 engine).

Editors Note: Due to the editorial lead required for timely publication of the FSM, numerical values are based on information available at the time the article is written. These values have not been formally adjudicated by the Air Force and, in many cases, values were derived from investigations still ongoing or investigations with pending final messages.

C-130

USAF Photo by TSgt Rick Sforza

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Overall, the mighty Herc had a pretty good year. Most important was the absence of a Class A mishap. This was the second straight year without a Flight Class A, which is great considering all the flight operations going on around the world. Compared to previous years overall, we are about average and as expected for an aging aircraft. A quick breakdown of total rate producing (Flight category) for FY07 is: 0 Class As, 15 Class Bs, and 74 Class Cs. There were also 2,117 reported Class E events. All versions of the C-130 combined for a total of 267,230 flight hours.

Of the 19 Class B mishaps (including Aviation Ground Ops, non-rate producing), 68 percent (13) were associated with the engine. When you add the 4 bird strikes which damaged the engine, 17 of 19 mishaps were powerplant-related. While this may seem high, it's good to know that the C-130 flies just fine on three engines. For a comparison, read the end-of-year article covering the F-16. Of the Class C mishaps, only a third were powerplant-related. The Class C cost range includes a variety of mishaps since powerplant mishaps typically drive them to the Class B cost threshold. Notably of the Class C mishaps, gear and brake mishaps occur about once a month.

Reporting of Class E events continues to be outstanding with a total of over 2,100. I know there are many flight safety officers and NCOs working diligently to enter all this information into the database for tracking. This is important information and enables us to track bird strikes, engine shutdowns, and smoke and fume events. All the bird strike information goes into the bird avoidance model to help identify trends and provide information to help

mitigation techniques. All of the engine data assists local wings to execute trends analysis and determine both local- and AF-wide issues. Overall, for Class E events, 54% are bird strikes and 31% are propulsion. The remainder covers the miscellaneous reporting requirements including flight control malfunctions, physiological events, HATRs, and HAPs.

Class B Mishaps

As previously mentioned, 17 of the 19 aviation flight and aviation ground ops mishaps were powerplant-related. This number includes a mix of engine confined FOD, bird strikes, bearing and blade failures, and of course gearbox failures. Unfortunately, 6 of the mishaps involved foreign object damage to the tune of $1.6 million. Of all the mishaps, these are probably the most preventable with better FO discipline and maintenance procedures. Obviously one washer or even a small bird down an intake can cause major damage to an engine.

There were two non-powerplant-related mishaps last year. A crew experienced unrecognized spatial disorientation while in a sustained descending turn on NVGs. The result was an extreme nose low attitude and high angle of bank. During recovery, the aircraft experienced negative Gs, causing injuries to the crew and several passengers. Also learned was an important reminder for pilots: if you are floating out of your seat, do not use the throttles to keep yourself seated. C-130s do not fly well with all four throttles pulled into the ground range during flight! Another important lesson is to not get complacent. Sometimes we think we're being nice by letting our passengers relax a little longer and not get back in their seats and strapped in. Remember the checklists are there for a reason and getting your passengers secure before descent is to keep them safe.

The other mishap involved the flap system. During flight, a ball nut became unseated and allowed the roller elements to escape from the assembly. When the flaps were moved, one of the jackscrew assembly failed, causing the flap to misalign resulting in damage to the flap, wing, and aileron. Luckily there was no problem controlling the aircraft, and in fact, the crew didn't even notice it in flight.

Class C Mishaps

Class C mishaps covered a much wider area. In addition to the expected propeller and powerplant issues, there were also several mishaps involving brakes, gear malfunctions, and hard landings. FY06 showed us what could happen when improper braking procedures were used when an aircraft was destroyed from a brake fire. Crews still need to be careful in hot environments to minimize brake use and take the time to cool them down if necessary before proceeding. There were also a few instances of hard landings due to misconfigured aircraft. It is always a good habit to do a final configuration check on short final.

Bird Strikes

The C-130 experienced 1,172 birdstrikes last year at a damage cost of over $2.85M. Four Class B strikes resulted in $1.35M in damage, all having been ingested in the engine. There were 26 bird strikes resulting in Class C damage. These are the birds that missed the engines, but managed to damage leading edges, radomes, and the occasional propeller. While their individual costs are fairly low, their combined total was over $1.26M in damage. More costly than the damage though, is the time it takes to refabricate a leading edge or fix a hole, making the aircraft unavailable for missions. Lastly, there were 1,145 Class E bird strikes. Luckily, the vast majority caused no damage to aircraft and are only recorded for trending and updating bird avoidance databases. Keeping a record is important, so keep up the great job of reporting. As crew dogs, we have lots of bird avoidance information available to us. Use it to make informed risk management decisions to mitigate the risks and avoid a damaging strike.

Summary

Air Force C-130s fly a wide variety of missions. Remain vigilant and avoid complacency during your missions. On each mission, look for a way to improve your skills, reduce your risks, or educate a crewmate on flying a safer Herc for the years to come. Fly safe!

C-130

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	0	0.00	15	5.61	0	0.00	0	0	267,230
5 YR AVG	0.6	0.20	10.2	3.39	0.4	0.13	0.4	1.8	300,954.2
10 YR AVG	0.9	0.31	8.4	2.86	0.5	0.17	0.4	2.5	293,621.6
LIFETIME CY55-FY07	151	0.87	226	1.30	88	0.51	138	638	17,346,896

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

F-15

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HQ AFSC/SEFF
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The USAF as a whole took a step back from the historic safety numbers set in FY06. The Fighter community was not immune to this trend, including the F-15. In fact, the Eagle community regressed significantly from one of its safest years ever. The USAF overall Class A rate increased from the historic 0.90 rate (per 100,000 flying hours) to 1.27. The Fighter/Attack rate increased from 1.94 to 2.64. The Eagle community unfortunately was a prime contributor to this increase going from 0.60 (the best year since 1974) to 3.72 (the worst year since FY99). This rate also exceeded the airframe's lifetime average of 2.38. Last year's rate reflects the 6 Class A mishaps experienced throughout the year (as compared to 2 in FY06). While these numbers are discouraging, the trend does not mean we have rested on our laurels from the previous year or let our collective guard down. Mishaps happen, sometimes in greater numbers than we expect. What matters is what we take from them and apply to future sorties.

Half of the Class As experienced in FY07 were due to bird strikes. All were experienced by F-15Es, which is not abnormal given the higher percentage of time close to the ground; however, two of these were close to the airfield where everybody has to fly sooner or later. Of these:

• An F-15E on a night low-level, struck multiple birds causing catastrophic damage to the number 2 engine. The crew successfully recovered the aircraft on one engine.

• An F-15E on final at a deployed location struck a single large bird and was able to complete the landing. The number 1 engine was severely damaged.

• Another F-15E sustained substantial bird strike damage while performing acrobatic maneuvers during a demonstration flight. Once again, the crew was able to successfully recover the aircraft, but the damage was severe enough to cross the Class A threshold.

The other three Class As were far more damaging, resulting in 3 destroyed aircraft and tragically, one fatality. It should be no surprise that all of these involved Human Factors to some degree.

• An F-15D pilot was unable to regain control of the aircraft following a BFM engagement and successfully ejected. The aircraft was destroyed.

• An F-15C had a midair collision with an F-16. The Eagle took the brunt of the collision and the Eagle

USAF Photo by MSgt Michael Ammons

driver successfully ejected. The Viper driver was able to recover his aircraft. No words yet on whether they have painted an Eagle on the side of the F-16.
• During a local training mission, an F-15A impacted the water and was destroyed, fatally injuring the pilot.

For complete lessons learned on all of these mishaps and more, contact your local Flight Safety Officer for the skinny.

Class B Mishaps

There were 13 Class B mishaps in FY07, one less than occurred in FY06. This slightly reverses the negative trend over the last 5 years. Half of these mishaps were engine-related, mostly due to FOD. There are a lot of fasteners on the aircraft and they don't always stay in place. This is an ever-increasing trend item across the fleet. Other Class Bs included two weather-related mishaps causing damage (lightning/electrostatic discharge), two dropped objects (one canopy and one pylon), one brake fire after a high-speed abort which damaged the Main Landing Gear, and one Nose Gear strut that broke during taxi. These are many of the same culprits from the previous year. Keep your pre-flights thorough and make sure to have a good plan for when things go wrong from start to shutdown.

Other Mishaps and Events

There were over 300 other mishaps and events reported in FY07. Many of the same trends continue from the last few years and are good indicators of what may become Class As and Bs in the future. Over 130 bird strikes were reported once again (5 in the Class C range). Although these numbers have remained fairly constant, remember half of the Eagle's Class As were due to birds. We may know the restrictions and follow them, but birds aren't as professional and routinely violate these agreements.

It should be no surprise that the other mishap leaders are engine/FOD mishaps, departures, and display problems. Jets will continue to have issues as they get older and we put new toys on them. The challenge is keeping the focus when we fly and maintain them.

Lessons Learned

Although the USAF and the Eagle community regressed from the historic aviation safety record of FY06, the mishaps we experienced were nothing new under the sun. We generally know how to avoid all of these. Sometimes we do everything right and still have mishaps, but there are always things to learn from them. Make use of your safety officers, challenge your flight members with "what ifs," and above all, have a good game plan for when things go wrong (because they most surely will). A majority of what you do every day in planning/stepping/flying has a foundation in mishap prevention. Keep up the good fight and happy hunting.

F-15

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	6	3.72	11	6.83	3	1.86	1	0	161,135
5 YR AVG	3.4	1.93	10.2	5.78	2.0	1.13	0.2	0.0	176,470.8
10 YR AVG	3.9	2.15	11.0	6.05	2.3	1.27	0.5	0.5	181,759.3
LIFETIME CY72-FY07	133	2.42	250	4.55	112	2.04	39	45	5,497,219

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

F-16

MAJOR (CAF) TERRY HOFFART
HQ AFSC/SEFF
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The Viper had a bad year! There were a total of 10 Class A flight mishaps reported in FY07 with a Class A flight mishap rate of 3.18 per 100,000 flight hours. Both these numbers exceeded the 10-year average for the F-16. Not only did we lose 8 valuable combat assets, we also had 1 fatality. If we also factor in 1 Class A flight-related mishap, 1 combat-related loss with fatality, and 1 midair collision which the Viper survived, it was indeed a dark year from the safety perspective! Let's take a closer look at last year's mishaps and see what we can learn.

Class A Mishaps

Of the 13 FY07 Class A mishaps, 6 were due to engine problems, 4 were due to aircraft loss of control in the air and on the ground, 2 were due to human factors, and 1 was due to collisions with another aircraft.

• F-16C Engine Failure (taken from the Accident Investigation Board Report). Shortly after selecting afterburner for takeoff, the mishap aircraft (MA) experienced an engine explosion followed by an engine fire. The mishap pilot (MP) aborted on the runway and egressed from the MA. The MA sustained significant damage and was declared a total loss. The cause of the explosion was a third stage fan disk failure. A region of overstress existed in a bolt hole of the third stage fan disk, which caused the bolt hole to fracture. This bolt hole fracture caused the other parts of the third stage fan disk to fracture during the initial power up for takeoff. These pieces of the engine created exit holes in the airframe. The openings penetrated the fuel tank and ignited a fire. A fuel-fed fire damaged the engine and aft portion of the airframe.

• F-16C Combat Loss (taken from the AIB Report). An F-16C was undergoing a non-traditional intelligence, surveillance, and reconnaissance (NTISR) mission. Approximately 3 hours into the sortie, a coalition helicopter made a hard landing and the MP's two-ship formation was tasked to provide NTISR support. A coalition ground force moving to secure the downed helicopter came under heavy attack from enemy forces, employing small/medium caliber weapons and rocket-propelled grenades. The MP was tasked by the joint terminal attack controller (JTAC) to engage enemy vehicles with his 20 millimeter cannon. While the MP's wingman returned to the tanker to refuel, the MP

USAF Photo by SSgt Joshua Strang

worked with the JTAC to positively identify the enemy vehicles by making several low passes. With clearance to engage, the MP made a high angle strafe (HAS) pass and employed the gun at minimum range, resulting in damage to an enemy vehicle. After recovering the aircraft at 200 ft above ground level (AGL), the MP immediately set up for a second HAS attack that placed the MA too low and too close to his intended target. During the second dive, the MP pressed his attack below a recoverable altitude and impacted the ground. The resulting impact destroyed the aircraft and the MP sustained fatal injuries. The cause of the mishap was the MP's channelized attention manifested by his desire to maintain a constant visual positive identification of targeted enemy vehicles and subsequent target fixation on these vehicles while they were traveling at a high rate of speed. These two factors, when combined, caused the MP to begin and then press his attack below a recoverable altitude. A contributing factor was the pilot's excessive motivation to succeed while operating in a dynamic and stressful combat environment.

• F-16D Engine Failure (taken from the AIB Report). The MP was on a surface attack profile and had just completed multiple high altitude bombing patterns. While setting up for low altitude bombing patterns, the mishap crew (MC) heard a loud bang and experienced decreasing thrust. The MC turned towards Gila Bend Auxiliary Airfield, informed the lead aircraft over the radio that they had an engine problem, and attempted two engine restarts. The MC, having confirmed that the engine was unresponsive and recognizing that the MA was at too low an altitude to make it to Gila Bend, safely ejected and sustained no injuries. A material failure in the diffuser case was the root cause of a chain of events that caused the MA to enter a non-recoverable engine stagnation and crash. Through post-crash analysis, it was determined that the diffuser case failed due to fatigue in the upper side of the weld on the combined AP4l igniter boss on the right hand side of the engine. The MC correctly determined that the engine could not be restarted, and the aircraft could not be recovered.

• F-16C Engine Failure. An F-16C experienced an engine failure while at a mid altitude cruise to the operating area. After multiple attempted restarts, the pilot successfully ejected.

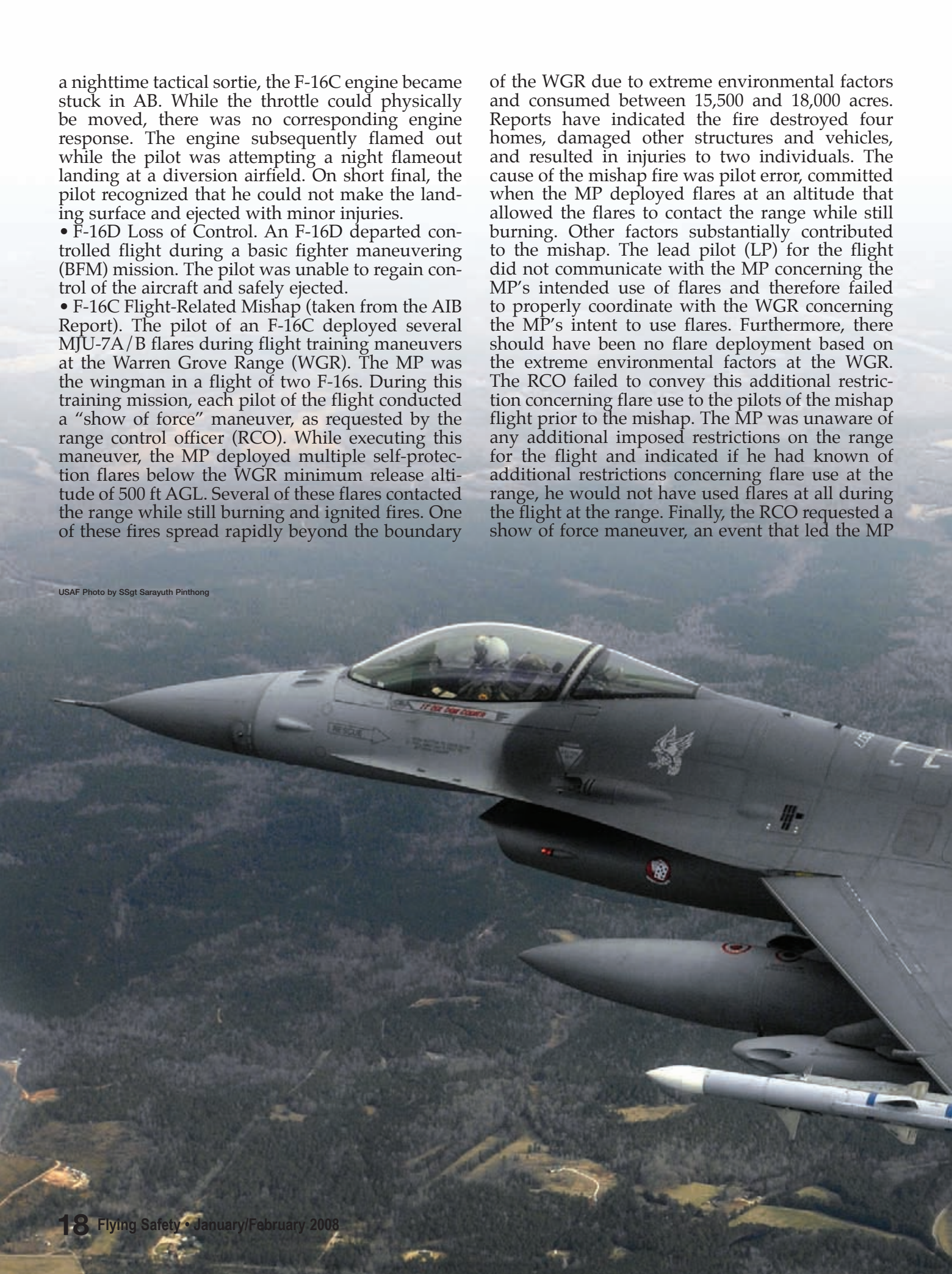
• F-16C Engine Stuck in Afterburner (AB). During

a nighttime tactical sortie, the F-16C engine became stuck in AB. While the throttle could physically be moved, there was no corresponding engine response. The engine subsequently flamed out while the pilot was attempting a night flameout landing at a diversion airfield. On short final, the pilot recognized that he could not make the landing surface and ejected with minor injuries.

• F-16D Loss of Control. An F-16D departed controlled flight during a basic fighter maneuvering (BFM) mission. The pilot was unable to regain control of the aircraft and safely ejected.

• F-16C Flight-Related Mishap (taken from the AIB Report). The pilot of an F-16C deployed several MJU-7A/B flares during flight training maneuvers at the Warren Grove Range (WGR). The MP was the wingman in a flight of two F-16s. During this training mission, each pilot of the flight conducted a "show of force" maneuver, as requested by the range control officer (RCO). While executing this maneuver, the MP deployed multiple self-protection flares below the WGR minimum release altitude of 500 ft AGL. Several of these flares contacted the range while still burning and ignited fires. One of these fires spread rapidly beyond the boundary of the WGR due to extreme environmental factors and consumed between 15,500 and 18,000 acres. Reports have indicated the fire destroyed four homes, damaged other structures and vehicles, and resulted in injuries to two individuals. The cause of the mishap fire was pilot error, committed when the MP deployed flares at an altitude that allowed the flares to contact the range while still burning. Other factors substantially contributed to the mishap. The lead pilot (LP) for the flight did not communicate with the MP concerning the MP's intended use of flares and therefore failed to properly coordinate with the WGR concerning the MP's intent to use flares. Furthermore, there should have been no flare deployment based on the extreme environmental factors at the WGR. The RCO failed to convey this additional restriction concerning flare use to the pilots of the mishap flight prior to the mishap. The MP was unaware of any additional imposed restrictions on the range for the flight and indicated if he had known of additional restrictions concerning flare use at the range, he would not have used flares at all during the flight at the range. Finally, the RCO requested a show of force maneuver, an event that led the MP

USAF Photo by SSgt Sarayuth Pinthong



to perform a low altitude simulated bombing pass that was not planned or briefed prior to the flight. The failure of the LP to communicate with the MP concerning the use of flares and to properly coordinate the MP's intent to use flares during the flight substantially contributed to the RCO's failure to convey additional restrictions concerning flare use to the pilots of the flight. Further, the failure of the RCO to convey additional restrictions concerning flare use to the pilots of the flight substantially contributed to the MP's lack of information concerning additional restrictions on flare use. The MP's lack of information concerning additional restrictions on flare use that were in place on the WGR substantially contributed to the MP's deployment of flares during the mishap flight. Finally, the MP's performance of the unplanned show of force maneuver substantially contributed to the MP's low altitude flare deployment.

• F-16C Midair Collision. An F-16C had a midair collision with an F-15C. The Eagle took the brunt of the collision and the Eagle driver successfully ejected. The Viper driver was able to recover his aircraft. It just goes to show that while the Viper may be small, it is tough!

• F-16C Loss of Control. An F-16C crashed immediately after takeoff on a night mission fatally injuring the pilot.

• F-16C Loss of Control. An F-16C suffered a nose wheel tire failure on takeoff and departed the runway. The pilot ejected safely and the aircraft was destroyed.

• F-16D Engine Stagnation. While carrying out a high angle of attack (AoA) training sortie, an F-16D suffered a compressor stall and subsequent engine stagnation resulting in significant turbine damage. The engine could not be relit and the aircraft was recovered via a flameout approach.

• F-16C Engine Fire. An F-16C suffered an engine oil hot light indication. After landing from a precautionary simulated flameout landing, a fire broke out in the engine inlet causing significant damage to the engine and airframe.

• F-16C Loss of Control. An F-16C departed controlled flight during a routine daytime training mission. The aircraft could not be recovered and the pilot successfully ejected.

For complete lessons learned on all of these mishaps and more, contact your local Flight Safety Officer for the latest.

Class B Mishaps

There were also 7 Class B mishaps in FY07 which also exceeded the 10-year average. Of the 7 mishaps reported, 6 were engine-related and 1 was an inadvertent canopy jettison. Two of the engine mishaps involved FOD, something that can be addressed by human intervention. Three of the mishaps were reported as Ground and Industrial mishaps as they occurred during maintenance procedures. One involved maintenance repair procedures, 1 involved FOD from an aircraft cover, and the final was an inadvertent canopy jettison by an incentive passenger.

Class C Mishaps

There were also 50 Class C mishaps reported in FY07 which were in-line with last year totals. As per last year, the biggest trend noted was landing gear and tire-related mishaps with 12 total reported. These mishaps included blown tires due to pilot error and system failures, hot brakes, and brake fires. This number was almost matched by landing errors where the pilot either landed short, landed hard, or scraped the tail on landing (9 total). In line with previous years, there were 5 Class C bird strikes reported along with 2 aircraft damaged during AAR.

Lessons Learned

Of the 68 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 / tire and landing events. Remember that the mission is not over until the jet is safely "back" in the chalks. If the approach is bad, the landing will likely get a similar rating. As professionals, don't be embarrassed to "take it around" in lieu of attempting to salvage the landing at all costs. You always need to have a game plan in mind every time you take off or land; expect the unexpected!

USAF Photo by SSgt Michael R. Holzworth

Our feathered friends continue to try to attain air superiority with almost 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. Always be aware 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 year's reporting, we again lost one valuable aircraft due to in-flight loss of control. As I stressed in last year's report, aircrew must remain cognizant of their operating envelopes, their aircraft configuration, and their emergency procedures. 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.

Again, FY07 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 closing, I'd like to exercise some literary license and pull some comments from an article published by my boss in the May 07, *Flying Safety Magazine*. In the article, he stated, "There is a disturbing trend this year in our destroyed aircraft statistics: the *human element*. In 5 of the 8 destroyed aircraft we have experienced thus far this fiscal year, human mistakes were either directly responsible for, or a direct contributor to the mishap. To put it another way, without our own preventable errors, we would have only 3 destroyed aircraft—ALL due to mechanical engine failure. I think we could all live with that." Some sobering thoughts. Fly safe & check six!

F-16

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	10	3.18	2	0.64	8	2.55	1	0	314,300
5 YR AVG	7.4	2.22	4.2	1.26	5.6	1.68	0.8	0.6	333,054.4
10 YR AVG	9.8	2.86	4.0	1.17	8.3	2.42	1.8	2.1	342,689.9
LIFETIME CY75-FY07	331	3.81	71	0.82	305	3.51	78	115	8,685,228

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

F-22

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Both the USAF as a whole, and the Fighter/Attack community in particular, regressed from their safest year ever in FY06. The USAF overall Class A rate (Class A mishaps per 100,000 flying hours) rose from 0.90 to 1.27. The Fighter/Attack rate also increased from 1.94 to 2.64. The good news for the Raptor community was it more than held its own, experiencing its safest year since inception. In fact, it would be hard to do better than a 0.00 rate (that's zero Class As for you history majors). Some may scoff that the Raptor's cumulative flight hours are still relatively low, yet this is still a noteworthy achievement. The million dollar threshold that makes a mishap a Class A is easy to pass when you're talking new airframes such as the F-22. It is not unusual for systems in their infancy to see high rates as they "learn to crawl." Raptor Class A rates for the last 3 years have gone from 24.89 to 11.09 to the aforementioned "donut" for FY07. That's a great trend especially for such a new and costly airframe.

Class B Mishap

Being that there are no Class As to talk about, let's look at Class Bs. Not a lot to talk about here either, as there was only one. On a transition (TR) sortie, the mishap aircraft ingested a bird into the number 2 engine. The pilot didn't have any indications of a bird strike and the damage was discovered by maintenance during the thru-flight inspection. Being that this was a TR sortie, the strike likely happened somewhere in the traffic pattern. The Bird Watch Condition was low for that time period, a testament to the fact that birds don't always follow our rules.

Other Mishaps and Events

Although the Raptor community had a great year regarding Class A and B mishaps, with the increased flight hours, it should be no surprise Class C and E mishaps have increased. In fact, the number of mishaps more than doubled (from 20 to 48) from the previous year. I warned last year that as the flight hours increase, bird strikes would likely increase as

USAF Photo by TSgt Justin D. Pyle

USAF Photo by SSgt Samuel Rogers

well. You should have bet the "over" for the year as bird strikes rose from 9 in FY06 to 23 in FY07. That's a significant increase that far exceeds the corresponding increase in flight hours. Once again, birds can't read or work the internet and therefore can't be blamed for not following our rules.

Another trend item is in-flight engine shutdowns due to various AMAD problems. There were 7 reported events of this type for the year, mostly due to oil servicing or oil sensor transducer problems.

Lessons Learned

Every new airframe will go through its eventual growing pains, but the Raptor seems to be going through this phase fairly well. The biggest contributor to this year's mishaps were bird strikes, and although we can't always tell when and where they're going to show up, if we continue to follow the rules, we can minimize their impact (that and a timely jink now and then). Keep the focus, keep up the good work, and fly safe.

F-22

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	0	0.00	1	0.00	0	0.00	0	0	12,827
5 YR AVG	0.4	6.87	1.6	27.49	0.2	3.44	0.0	0.0	5,820.4
10 YR AVG	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LIFETIME CY02-FY07	3	10.27	8	27.38	1	3.42	0	0	29,217

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

A-10

BY MAJ TOM FERENCZHALMY
HQ AFSC/SEFF

The A-10 community completed another demanding year of flying without a single Class A mishap. This is no small feat and took everyone's dedicated efforts and keen eyes to accomplish. Unfortunately, our pride is somewhat tarnished by the fact that the community experienced a total of 9 Class B mishaps (between $200K and $1 million) with a rate of 8.4 per 100,000 flight hours, a significant increase over last year's 6 Class Bs (5.28/100k hrs). All were engine-related mishaps and are broken out as follows: 4 due to FOD, 2 undetermined compressor stalls, 1 due to a bird strike, 1 due to low engine oil pressure, and 1 ground mishap due to an engine tailpipe fire during start. A summary of this year's Class Bs follows.

The first Class B of the year occurred as a result of a water intrusion plug being ingested by the number two engine during a BFM sortie. Prior to flight, the plug had become detached from a "spider" lanyard for the right side of the aircraft which ties together multiple plugs and was not removed from an aft-facing avionics cooling port. The aircraft was recovered to home base without further incident.

Class B number two was also due to engine FOD. In this mishap, the number two engine ingested the windshield wash filler cap after it separated from the forward right-hand side of the aircraft during the low altitude tactical navigation portion of the sortie. The number two engine compressor stalled and was subsequently shut down. Damage was also sustained by the right slat. The aircraft was safely recovered without further incident.

Class B number three was due to 2 bird strikes that occurred during a night airstrike control mission. Two Ring-Billed Gulls impacted the aircraft – one on the left vertical stabilizer and the other on the number one engine fan spinner. The spinner disintegrated and was ingested by the engine along with the bird, resulting in moderate engine damage. No abnormal indications other than an unusual "roughness" of the engine was noted, and the aircraft was recovered uneventfully to a divert base.

Class B numbers four, seven, and eight were all compressor stalls, at least 2 of which occurred during low altitude operations. These investigations are ongoing.

Class B number five was due to an engine failure immediately after takeoff that resulted in a loss of RPM indications and oil pressure on the number two engine. The engine was shut down and the aircraft was uneventfully recovered. The investigation is ongoing.

Class B number six was a ground mishap due to a tailpipe fire during number two engine start. The engines were shut down and the pilot successfully emergency ground-egressed. The crew chief verified the fire was extinguished. The mishap engine sustained extensive damage to include a broken turbine blade.

Class B number nine was due to undetermined foreign object damage that was not discovered until aircraft post-flight. This investigation is ongoing.

Class Cs (each between $20k and $200k) – A total of 49 Class Cs were reported for FY07 as compared to 41

USAF Photo by TSgt Parker Gyokeres

for FY06. Class C dominant trends were slat failures and various gun malfunctions. Probably the most concerning Class C was a midair collision between number three and number four of a four-ship after the entire formation went lost wingman during RTB. Both aircraft recovered safely and without further incident, but this obviously could have been much worse than how it turned out. See your local flight safety officer to review this mishap and incorporate some lessons learned into your flight briefs.

Bird Strikes – A total of 183 bird strikes were reported, some with multiple strikes. The overall breakdown is 172 Class Es (each < $20k), 10 Class Cs, and 1 Class B. Though the vast majority of these bird strikes required little more than some soap, water, elbow grease, and of course paperwork, a small percentage of them did inflict serious damage despite the Hawg's substantial armor. It's a given that there are those "who have" and those "who will" have a bird strike and the longer you fly the Hawg, the more likely you are to have one that will really get your attention. With plenty of flying going on in the AOR where bird mitigation programs are often less than ideal and bird activity is often high, it pays to stay vigilant since you may be the one to spot this threat.

The overall trends appear to be an increased number of compressor stalls, slat failures and gun malfunctions. Though materiel aspects certainly contributed to these trends, there are other elements where pilots and maintenance can help mitigate the risk. The one thing everyone can and must do is to keep their awareness up and trust their instincts when something doesn't seem quite right. Speak up and question things if something is a little odd instead of assuming others have seen the same thing and called it good. Taking another minute or two to do a walkaround or post-maintenance inspection could pay big dividends in time, parts, or possibly your pink hide and jet. See your local flight safety officer for additional information on the mishaps summarized in this article. ATTACK!

A-10

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	1	0.00	8	0.00	0	0.00	0	0	107,089
5 YR AVG	1.0	0.87	5.8	5.04	0.8	0.70	0.4	0.4	115,034.6
10 YR AVG	1.4	1.21	5.7	4.91	1.2	1.03	0.5	0.5	116,048.5
LIFETIME CY72-FY07	101	2.21	103	2.25	101	2.21	51	58	4,570,937

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

Strategic Airlifters

BY MAJOR KEVIN MCGOWAN
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While the mishap numbers show that FY07 was definitely a regression from FY06 on an Air Force-wide level, on the positive side, there were no loss of aircraft and no fatalities in the strat airlift world in FY07.

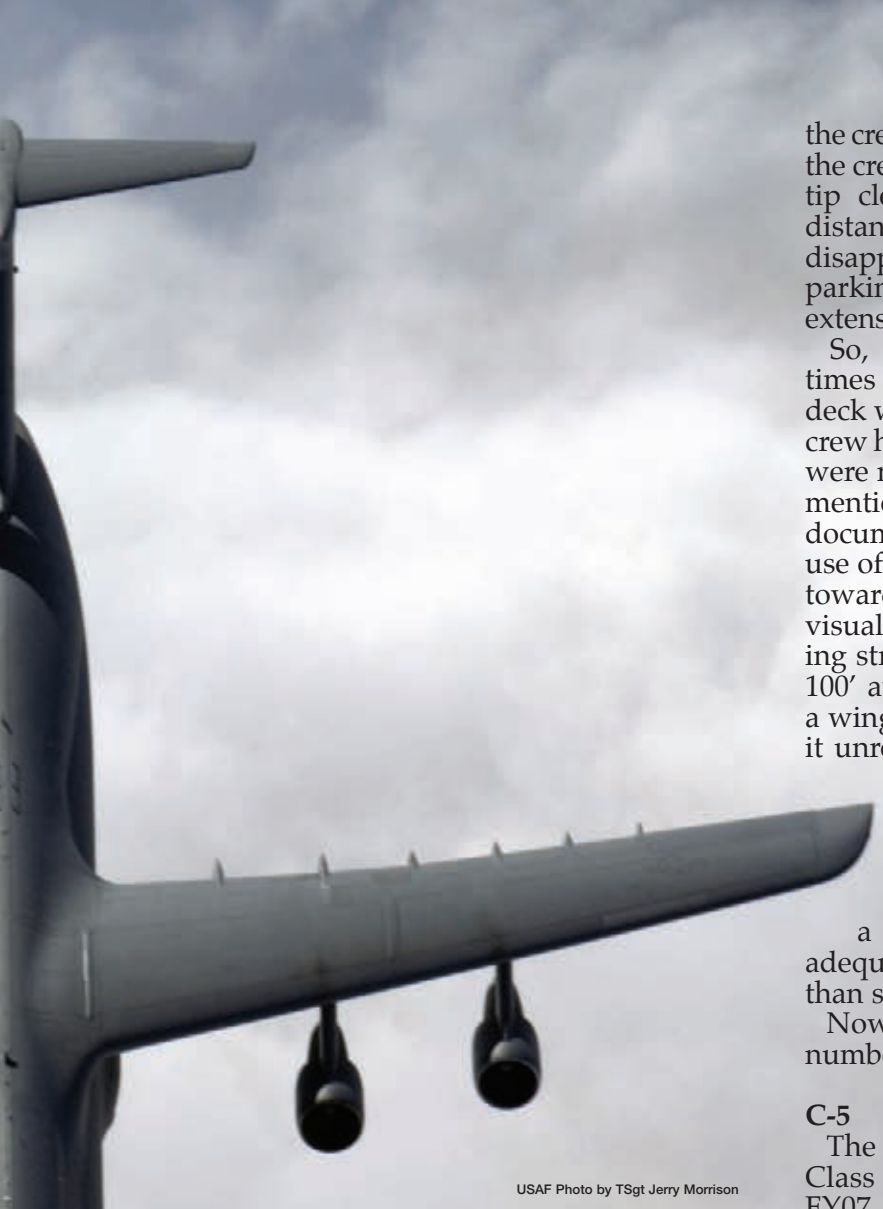
As it turned out, FY07 was not a good year for "big bird - little bird" relations. More to the point, bird strikes. The C-5 community had the distinction of having 142 bird strike incidents, resulting in 1 Class A mishap which occurred on departure (causing $2,819,844 in damages), 1 Class B mishap which occurred on arrival (totaling $797,728 in damages), 2 Class C mishaps (causing $69,055 in damages), and 138 Class E mishaps. The C-17 community, on the other hand, clocked in with an amazing 661 reported bird strike incidents (about 4.6 times as many as the C-5), resulting in 15 Class C mishaps (totaling $1,188,630 in damages) and 646 Class E mishaps.

So how can we mitigate the risk from repeating this in the future? While an obvious answer is to stop flying, this is certainly an unacceptable one. So what is the answer? Unfortunately there is no silver bullet on this one, but there are a few tools available to the aviation community to help reduce the risk. One of these tools is the U.S. Bird Avoidance Model (BAM) located at http://www.usahas.com/bam/. Another very handy tool is the BASH map on the wall of your friendly neighborhood Base Ops. The Air Force is also working on the small mobile radar (SMR), which should be able to provide real-time bird warnings.

These fancy high tech tools aside, perhaps the best tool is the Mark-1 Eyeball. If you see birds, report it to the tower. Just because you see birds in the airfield vicinity, it doesn't necessarily mean that everyone else does. At least if you report it, other aircraft can be advised on the progress of those feathered hazards.

With respect to planning, if you know that you're going into a high bird threat area, then do your best to mitigate the risk by avoiding the dawn and dusk windows (assuming operations allow for this type of flexibility).

Another disturbing issue that has presented itself again is an apparent reluctance to make that difficult call. More to the point, on more than one occasion during FY07, mishaps occurred or were compounded by crew members not speaking up or taking action to ensure the aircraft was operated safely. One such occurrence involved a late decision to go around following an improperly flown tactical approach. The end result was a long touchdown that prompted one pilot to attempt a go around, while the other attempted to stop the aircraft. In the end, the aircraft only experienced a brake fire, but the outcome could have been far worse. In this case, the pilot not flying (PNF) suggested that they should go around on more than one occasion, but the pilot flying (PF) chose to continue anyway. In this situation, had the PF chosen to listen to the PNF or had the PNF opted to take control, the aircraft could have been repositioned for a more stable approach, and the whole situation could have been avoided.



USAF Photo by TSgt Jerry Morrison

Another incident worth noting occurred at a location that is frequently transited by both the C-17 and the C-5. After a long day complete with ground delays, an AR, and maintenance divert, the mishap crew was instructed to park in an engine run spot that none of the crew members had ever parked in before. To complicate matters, positioning the aircraft in the spot would require a 90º turn to parallel a blast fence followed by another 90º turn into the spot. Unfortunately the fact that this spot was not authorized for this size of aircraft (unless towed into the spot) was never relayed to the mishap crew nor was it posted in the Airfield Suitability and Restrictions Report or NOTAMs.

Recognizing the potential taxi obstacle, the mishap crew placed a scanner in the window, but unfortunately a combination of an improperly trained wing walker (giving the crew a "thumbs up") and a wing tip clearance visual illusion (caused by the blast fence actually sloping towards the ramp rather than away from the ramp) led to the crew having a false sense of security. Now while the crew rolled out of the first turn with some wing tip clearance (less than the required minimum distance), the actual remaining clearance quickly disappeared during the second 90º turn into the parking spot (due to wing tip growth), resulting in extensive wing tip damage.

So, what can we learn from this? How many times have you been on the road and felt that the deck was stacked against you? In this instance, the crew had been instructed to park in a spot that they were not authorized to taxi into, and there was no mention of this restriction in any crew accessible documentation. Nor was there any mention of the use of a rarely seen blast fence that actually slopes towards the ramp rather than away from it (a visual illusion that is difficult to detect when looking straight onto it, especially from a cockpit over 100' away). And to top it off, the crew was given a wing walker. Now put yourself in their shoes. Is it unreasonable to trust the wing walker and the documentation? While most of us would say no, ultimately the safe operation of the aircraft falls upon the A/C. When in doubt, even if you have an airfield supplied wing walker, stop the aircraft, deplane a scanner, and ensure you do in fact have an adequate amount of wing tip clearance. Better safe than sorry.

Now let's take a minute to look at fleet specific numbers.

C-5

The C-5 community fell victim to another two Class A mishaps and four Class B mishaps in FY07. Unfortunately, this is the same number of Class A and Class B mishaps as those experienced in FY06. The Galaxy community also experienced a remarkable 20 Class C mishaps in FY07, which was an increase from the 17 experienced in FY06. As we learn from history, let's take a closer look into what happened.

While the first Class A mishap was a result of the aforementioned bird strike, the second involved ground operations which resulted in $1,019,238 of damage. As for the remaining Class B and C mishaps, there weren't any overwhelming trends worth discussing. With that being said, however, of the 4 Class B and 20 Class C mishaps, 8 were engine-related, 6 were MLG-related (brakes, tires, retraction, etc.), and 3 were bird-related. While little can be done from the cockpit to prevent engine problems, we must continue to fine-tune those emergency procedure skills and knowledge. An effort should also be made to refamiliarize ourselves with ways to prevent hot brakes and what to do in the event that we are actually faced with them (FY07 saw 3 C-5 brake fire incidents and 1 instance of deflated tires).

C-17

In light of the C-17's very active mission and the locations it's operating in and out of, the Globemaster III community faired fairly well overall. This year the C-17 community clocked in with another two Class A mishaps and another two Class B mishaps (the same number of Class As and Bs as FY 06). Unfortunately, also like the C-5 community, the C-17 experienced an increase in Class C mishaps to 68, up from 55 in FY06, 50 in FY05, and 38 in FY04.

But unlike the Galaxy community, the Globemaster III community's two Class A mishaps were a result of engine failures. One of the mishaps occurred in the local training pattern resulting in damages totaling $1,380,136 and the other occurred at cruise with $3,346,605 in damages. As for the two Class B mishaps, one was engine-related and the other was the result of a hard landing and subsequent wing strike which damaged not only the MLG but also the wing.

The real trends start to materialize when you take a look at the Class C mishaps. Of the 68 Class C mishaps on the books, 21 of them were engine-related (33 if you include the engine failures due to bird ingestion), 16 were the result of bird strikes, 11 were landing gear-related, and 9 involved dropped objects (including, but not limited to 9, ram inlet doors, access panels, MLG, and flap and spoiler components).

While not much can be said about the mechanical failures that occurred nor the bird strikes (beyond what has already been said), vigilance is the order of the day. FY07 saw a full spread of issues plague the C-17 community, ranging from engine failures to blown tires to dropped objects. We constantly

C-5

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	1	2.20	4	8.81	0	0.00	0	0	45,397
5 YR AVG	1.4	2.06	2.8	4.11	0.2	0.29	0.0	0.0	68,096.4
10 YR AVG	0.8	1.20	2.3	3.44	0.1	0.15	0.0	0.0	66,860.0
LIFETIME CY68-FY07	23	0.99	56	2.41	5	0.22	5	168	2,325,169

train for that emergency situation we all pray never happens to us. Unfortunately, it's only a matter of time before "the other guy" is you. So, how can you prepare for that unknown situation? Stay in the books and use the simulator to master those difficult scenarios. Remember, practice makes perfect and when the unthinkable happens, you'll be grateful for those hours spent in the sim mastering that very event.

Lessons Learned

As you are already abundantly aware, the strat mission brings us to obscure locations, each with its own challenges. And while we may not be able to anticipate every emergency, it is crucial that we all remain on top of our game for whatever situation is thrown our way. It's rather amazing how many mishaps occur as a result of the crew taking improper action or no action at all. Large aircraft have a distinct advantage over smaller aircraft in that we carry a larger crew compliment. Each crew member holds a valuable piece to the puzzle. And when something doesn't seem right, there's probably a good reason for that, and you may not be the only one who feels that way (even though you may be the first to voice it). The key is to make your concerns known as you may hold the critical piece to that puzzle that may break that proverbial chain of events leading to a mishap. In the end, don't hesitate to speak up and encourage everyone else on your crew to do the same. Use the "Time Out" card if required. Who knows? Your insight into a situation or your call to "go-around" may just save your aircraft, your life, and the lives of your fellow crew members.

U.S. Army Photo by Sgt. 1st Class Joe Belcher

C-17

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	1	0.58	3	1.73	0	0.00	0	0	173,070
5 YR AVG	2.6	1.61	4.6	2.85	0.0	0.00	0.0	0.0	161,162.2
10 YR AVG	1.6	1.39	3.9	3.38	0.0	0.00	0.0	0.0	115,448.3
LIFETIME CY91-FY07	18	1.47	41	3.36	0	0.00	0	0	1,221,239

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

Surveillance/Recce

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USAF Photo by MSgt Robert Wieland

Overall, Surveillance/Recce experienced a good year with only 1 Class A and 1 Class B mishap.

E-3B/C

Overall, the E-3 Airborne Warning and Control System (AWACS) community had a great year with no Class A (FY06–0), no Class B (FY06–2), and 8 Class C (FY06–4) mishaps in FY07. The Class C mishaps were made up of 3 engine mishaps, 2 hydraulic mishaps, 1 burned up computer control power supply, 1 flap mishap, and 1 lightning strike. Additionally, the AWACS experienced 80 Class E (FY06–92) events. Of those 80 Class E events, 31 were classified as miscellaneous, 22 were BASH events, 19 were propulsion-related, 4 were flight controls, 3 were physiological events, and 1 was a HAP. No trend was identified.

E-4B

Overall, the E-4 National Airborne Operations Center (NAOC) community had a great year with no Class A (FY06–0), no Class B (FY06–0), and 1 Class C (FY06–1) mishap in FY07. The Class C was an engine mishap. Additionally, the E-4 experienced 17 Class E (FY06–21) events. Sixteen of the 17 Class E events were BASH events. The remaining Class E was classified as miscellaneous. No trend was identified.

E-8C

Overall, the E-8 Joint Surveillance and Target Attack Radar System (JSTARS) had a good year with no Class A (FY06–0), 1 Class B (FY06–0), and 3 Class C (FY06–6) mishaps in FY07. The Class B mishap was the result of domestic object damage. The 3 Class C mishaps were engine mishaps. Additionally, the E-8 experienced 58 Class E (FY06–93) events. Of the 58 Class E events, 22 were BASH events, 18 were propulsion events, 11 were classified as miscellaneous, 2 were HATRS, 1 was flight controls, and 1 was a physiological event. Recommend focusing E-8 mishap prevention efforts on engines in FY08.

RC-135V/W/S/U

The RC-135 Rivet Joint/Combat Sent/Cobra Ball community had a great year with no Class A (FY06–0), no Class B (FY06–0), and 4 Class C (FY06–3) mishaps in FY07. Of the 4 Class C mishaps, 2 were bird strikes and 2 were related to the brakes. Additionally, the RC-135 experienced 68 Class E (FY06–67) events. Of the 68 Class E events, 45 were BASH events, 11 were classified as miscellaneous, 8 were propulsion events, 2 were HATRs, and 2 were flight control events. Recommend focusing RC-135 mishap prevention efforts on BASH in FY08.

U-2S

The U-2 Dragon Lady experienced 1 Class A (FY06–0), no Class B (FY06–0), and 2 Class C (FY06–4) mishaps. The Class A mishap was the result of the Lower Q-Bay Hatch coming out in flight. An engine mishap and a hydraulic mishap made up the 2 Class C mishaps. Additionally, the U-2 experienced 19 Class E (FY06–14) events. Of the 19 Class E events, 8 were physiological events, 7 were classified as miscellaneous, 2 were BASH events, and 2 were instrument events. No trend was identified.

E-3

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	0	0.00	0	0.00	0	0.0	0	0	17,233
5 YR AVG	0.0	0.00	1.6	8.59	0.0	0.00	0.0	0.0	18,822.0
10 YR AVG	0.0	0.00	1.0	4.96	0.0	0.00	0.0	2.0	20,172.0
LIFETIME CY77-FY07	1	0.14	12	1.72	1	0.14	2	24	695,776

E-4

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	0	0.00	0	0.00	0	0.00	0	0	1,679
5 YR AVG	0.4	24.90	0.8	49.81	0.0	0.00	0.0	0.0	1,606.2
10 YR AVG	0.3	19.56	0.6	39.12	0.0	0.00	0.0	0.0	1,533.6
LIFETIME CY75-FY07	5	9.23	8	15.77	0	0.00	0	0	54,156

E-8

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	0	0.00	1	7.62	0	0.00	0	0	13,121
5 YR AVG	0.0	0.00	0.4	3.65	0.0	0.00	0.0	0.0	10,948.4
10 YR AVG	0.1	1.29	0.3	3.87	0.0	0.00	0.0	0.0	7,748.7
LIFETIME FY91-FY07	1	1.22	3	3.65	0	0.00	0	0	82,243

RC-135

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	1	0.43	16	6.92	0	0.00	0	0	231,364
5 YR AVG	0.6	0.25	11.2	4.65	0.0	0.00	0.0	0.0	241,087.4
10 YR AVG	0.5	0.22	6.7	3.01	0.1	0.04	0.2	0.4	222,602.7
LIFETIME CY57-FY07	82	0.60	185	1.36	64	0.47	134	629	13,562,958

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	
FY07	1	6.55	0	0.00	0	0.00	0	0	15,270
5 YR AVG	0.6	4.31	0.0	0.00	0.4	2.87	0.2	0.2	13,916.6
10 YR AVG	0.6	4.66	0.0	0.00	0.2	1.55	0.1	0.1	12,875.1
LIFETIME CY63-FY07	31	6.43	1	0.21	22	4.56	8	13	482,348

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

Tankers

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USAF Photo by Judson Brohmer

Tanker stats for the past year indicate little in the way of trends (both airframes). Depending on your perspective, this can be good or bad. Good if one is concerned with a fleet-wide single component trend failure; bad if one fears an overall aging airframe with a lot of different components failing. But don't worry – despite the aging nature of the fleet, we're not seeing any significant safety issues with critical components, like oh … I dunno, wings. I believe we benefit from very good maintenance practices and logistics-level sustainment support toward that end.

One KC-135R trend that is a carryover from last year and will be for the foreseeable future, is the problem of METCO de-lamination. While the fleet experienced 6 METCO identified failures this year, the total is lower than the 8 from last year. However, as the F-108 (no that's not a new aircraft, that's the military designation for the CFM-56 variant) accumulates more hours, expect continued METCO failures.

KC-10s mishaps in FY07
1 Class A (FY06–2)
6 Class B (FY06–4)
8 Class C (FY06–15)
79 Class E (FY06–43)

The large increase in Class E events can be largely attributed to drogue reel test failure reporting.

USN photo Navy Lt Peter Scheu

KC-135s mishaps in FY07
1 Class A (FY06–1)
18 Class B (FY06–18)
73 Class C (FY06–71)
151 Class E (FY06–155)

Air Refueling

Last year was a sobering year for A/R, with 28 Class B/C mishaps just for the KC-135. This year, there were a total of 11 A/R mishaps for both MDSs (no Class As). Well deserved praise is warranted for the tanker force at large with, in our opinion, special recognition to the boom operators for their assertiveness and back to basics focus.

KC-10

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	1	1.49	5	7.48	0	0.00	0	0	66,812
5 YR AVG	1.2	1.92	2.6	4.18	0.0	0.00	0.0	0.0	62,186
10 YR AVG	0.9	1.52	2	3.39	0.0	0.00	0.0	0.0	58,866.3
LIFETIME CY81-FY07	13	1.06	25	2.04	0.0	0.00	0.0	0.0	1,223,385

KC-135

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	1	0.43	16	6.92	0	0.00	0	0	231,364
5 YR AVG	0.6	0.25	11.2	4.65	0.0	0.00	0.0	0.0	241,087.4
10 YR AVG	0.5	0.22	6.7	3.01	0.1	0.04	0.2	0.4	222,602.7
LIFETIME CY57-FY07	82	0.60	185	1.36	64	0.47	134	629	13,562,958

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

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

Trainers

BY MAJ TIM ARNOLD
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USAF Photo

T-1

The T-1 community continued its string of strong safety performances: 4 straight years without a Class A, 3 straight without a Class B, and a third year in a row with only 3 Class C mishaps. One of the Class Cs occurred when a civilian FBO employee towed a T-1 parked at an air show, damaging the nose landing gear. Another T-1 suffered hail damage, and the third Class C resulted from an engine malfunction.

T-1s reported 185 Class E events in FY07, a 30% increase from FY06. A whopping 152 of these were bird strikes, compared to 142 in FY06. The good news is that no aircraft were damaged by these bird strikes, while 2 FY06 strikes caused Class C damage ($20K-$200K).

Of the remaining 33 Class Es, 13 involved smoke and fumes, and 9 involved flight control issues where an out-of-tolerance flight control servo or pitch motor caused the aircraft to deviate from pilot or autopilot inputs. As in any aircraft with an autopilot, aircrew vigilance is necessary during all phases of flight.

T-1 pilots also reported 4 near-midair collisions, 3 of which occurred in the traffic pattern, highlighting the need to see-and-avoid whenever flying in VMC.

T-6

For a third straight year, the T-6 did not experience a Class A mishap, and for the second time in 3 years, there were no Class Bs either. Class C mishaps continued a downward trend, going from 14 in FY05, to 9 in FY06, to just 7 in FY07. This decrease is even more dramatic when you consider the 40% increase in flying hours over these 3 years.

Two Class C trends warrant mention: for the second year in a row, a pilot inadvertently activated the Canopy Fracture System (CFS), and the number of engine chip events doubled from FY06 to 4. Engine malfunctions in a single engine trainer highlight the need to always have a "hip pocket plan."

The T-6 community reported 154 Class E events in FY07, including 102 bird strikes and 4 HATRs. Eight AHRS or ADC failures caused a crew to lose 2 or more heading and attitude references. Combined with a Class C ADC failure, loss of instrumentation continues to be a long-term trend in the T-6.

Continuing with the theme that engine health is critical on a single engine aircraft, it is worth noting students inadvertently shut down the engine during a critical phase of flight. This same error caused 1 of the 2 Class A mishaps in the history of the Texan II and has been a trend over the life of the airframe.

T-37

The T-37 posted a second straight year with no Class A mishaps and has not had a Class B mishap in more than 10 years. Class C mishaps decreased from 11 in FY06 to just 6 in FY07. Even considering the 20 percent decrease in flying hours, this is an improved Class C rate. Five of these mishaps involved engine damage, combined with 15 Class E propulsion events, emphasizing the need for proficiency in single-engine procedures.

Overall, the T-37 experienced 119 Class E events. In addition to the engine events, other trends included 45 bird strikes and 5 HATRS.

T-38

The T-38 community experienced 2 Class As in FY07 with 2 destroyed aircraft and no fatalities. The first occurred during the low-level portion of a student formation training mission when the number two aircraft struck multiple large birds and shattered the front canopy, fragments of which FOD'ed out both engines. The crew climbed away from the ground, lost the ability to maintain altitude, and ejected. Neither crew member was injured. The second Class A occurred during an IFF BFM training sortie. The flight lead's aircraft departed controlled flight while at medium altitude and in between BFM training sets due to a secondary flight control failure. The solo pilot was unable to regain control of the aircraft, successfully ejected, and sustained only minor injuries.

Three Class Bs occurred this fiscal year and were all due to bird strikes that resulted in severe engine damage. The first occurred during the final turn of an overhead pattern, the second during a formation approach, and the third during low altitude bombing range operations. All aircraft were safely recovered.

The T-38 community experienced 70 Class Cs throughout FY07, more than a 50% increase over last fiscal year. About 69% (48) of these mishaps were attributed to engine damage (excluding engine damage caused by bird strikes). Two major trends in engine mishaps developed over the year and account for the increase in total number of Class Cs: overtemps due to stuck nozzles and compressor stalls. Bird strikes created the second highest number of Class Cs (15) with many resulting in engine damage. Loss/damage of canopies placed third with 4 occurrences. Two air conditioning failures and a fire on takeoff accounted for the remaining 3 Class Cs. See your local safety office for additional information on these mishaps.

T-43

Once again, the T-43/CT-43 community compiled a nearly flawless safety record in FY07. Extending its streak to 11 years of no Class A or B mishaps, the MDS had only 5 reportable events last year. One was an electrical odor in flight, 3 were bird strikes resulting in no aircraft damage, and the last was a bird strike with approximately $1,000 damage.

T-1

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	0	0.00	0	0.00	0	0.00	0	0	97,803
5 YR AVG	0.2	0.20	0.2	0.20	0.0	0.00	0.0	0.0	100,924.8
10 YR AVG	0.1	0.10	0.8	0.81	0.0	0.00	0.0	0.0	98,427.3
LIFETIME FY92-FY07	1	0.08	8	0.68	0	0.00	0	0	1,182,941

T-6

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	0	0.00	0	0.00	0	0.00	0	0	118,742
5 YR AVG	0.4	0.48	0.8	0.95	0.2	0.24	0.4	0.4	83,785.0
LIFETIME FY00-FY07	3	0.66	5	1.10	2	0.44	2	2	454,144

T-37

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	0	0.00	0	0.00	0	0.00	0	0	72,958
5 YR AVG	0.4	0.33	0.0	0.00	0.4	0.33	0.0	0.0	121,853.8
10 YR AVG	0.5	0.31	0.0	0.00	0.5	0.31	0.1	0.3	159,047.3
LIFETIME CY56-FY07	138	1.02	31	0.23	136	1.01	27	78	13,525,228

T-38

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	2	1.70	3	2.55	1	0.85	0	0	117,590
5 YR AVG	1.4	1.07	1.8	1.38	0.8	0.61	0.2	0.2	130,721.2
10 YR AVG	0.9	0.66	1.2	0.87	0.7	0.51	0.1	0.4	137,300.4
LIFETIME CY60-FY07	198	1.47	101	0.75	189	1.41	76	138	13,438,374

T-43

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	0	0.00	0	0.00	0	0.00	0	0	3,721
5 YR AVG	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.0	4,221.6
10 YR AVG	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.0	4,677.9
LIFETIME CY74-FY07	1	0.29	6	1.77	1	0.29	2	35	364,701

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

UAS

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Unmanned Aircraft Systems (UASs) continue to provide combatant commanders valuable intelligence, surveillance, and reconnaissance solutions. Further, some UASs provide real-time weapons effects. In addition to these valuable capabilities, UASs are the platform of choice when it comes to dirty, dangerous, and high duration missions.

UAS Midair Collision Hazard

On average, UAS mishap rates continue to exceed current manned aircraft mishap rates. Fortunately, the UAS midair collision hazard has yet to manifest any loss of life or damage to an airborne aircraft. Nevertheless, the midair collision hazard will grow as UASs have a larger requirement to access the NAS. As a result, the UAS midair collision hazard is a high emphasis safety item. The root cause for the UAS midair collision hazard is a lack of see-and-avoid capability.

Hazardous air traffic reports are the primary safety reports that provides insight into the midair collision hazard. This year there were a total of 13 Class E HATRs filed by both the UAS and manned aircraft communities involving a UAS. This number is small compared to many manned platforms, but given the small number of UAS flying hours, this number merits attention.

Analysis of the UAS midair collision hazard reveals there are two primary mitigation strategies. The first is to segregate the UAS from other aircraft, and the second is to design out the lack of see-and-avoid with technology.

Segregation can be accomplished via special use airspace mechanisms ranging from time and altitude deconfliction to placing UASs in restricted airspace. Segregation can be very effective, but it comes at a price of increased planning and procedures. Also, when UASs are co-located with manned aircraft, such as at Balad, Iraq, segregation has limitations in its effectiveness.

This leads us to the second mitigation strategy: technology that designs out the underlying UASs' see-and-avoid hazard. A key technology that will definitively design out the midair collision hazard is an onboard sense-and-avoid device. With a true sense-and-avoid capability, UASs will automatically detect a traffic conflict and generate a safe miss distance. Unfortunately, sense-and-avoid currently only exists at the national laboratories and will not be fielded for years.

A current technology that can mitigate the midair collision hazard is the Traffic Collision Avoidance System (TCAS). Although not as effective as sense-and-avoid, TCAS would greatly enhance UAS operators' situational awareness of traffic conflicts. Of the 13 HATRs in FY07, six involved TCAS alerts reported by manned aircraft. All medium and high altitude UASs have Identification Friend or Foe, but none have TCAS at this time.

Until technology designs out the UAS midair collision hazard, UAS operators and manned aircraft pilots must remain vigilant to ensure separation. Further, airspace planners must continue to create special use airspace to segregate UASs from manned aircraft.

MQ-1 Predator

The MQ-1 Predator, the workhorse of the US Air

USAF Photo by SSgt Suzanne M. Jenkins

Force UASs, had a very productive year with over 97,000 flying hours. In addition to its Multi-spectral Targeting System (MTS), it carries the AGM-114 Hellfire missile, capable of penetrating medium armor. This year marks the arrival of the much awaited Predator Mission Aircrew Training System (PMATS). PMATS is a high fidelity simulator, greatly enhancing aircrew training and doing much to mitigate the Predator landing hazard. Prior to this year, the primary factor causing Predator Class As was landing mishaps. In FY07, power plant moved up to be an equal factor responsible for Predator Class As. In FY07 the MQ-1 totaled 5 Class As with a mishap rate of 6.3 per 100,000 flying hours. There was only one Class C mishap. There were a total of 9 Class E reports. One Class E documented a departure from controlled flight with a successful recovery, which is quite unusual given the aircraft is flown via data link.

RQ-4 Global Hawk

The Global Hawk's (GH) synthetic aperture radar continues to survey large geographic areas with pinpoint accuracy for the global war on terrorism (GWOT). FY07 marked the GH's first operational year at Beale AFB, CA. This marked the first operational base for the GH within the US. As a result, the Air Force Safety Center, the GH Program Office, and Air Combat Command accomplished an Operational Safety Assessment to verify if the GH is safely operating within the National Airspace System at Beale AFB. This report is in final coordination. The GH logged just shy of 6,000 flying hours this year with zero Class A, B, or C mishaps, giving it a Class A mishap rate of zero. There were a total of 4 Class E events, one of which while deployed. The other 3 Class Es involved lost link and unanticipated altitude deviations.

MQ-9 Reaper (chart data not available)

The MQ-9 Reaper, the Air Force's first hunter-killer UAS, continued to grow in its role in the GWOT. With a 900-horsepower turbo-prop engine and a 64-feet wingspan, it provides commanders with a large weapons payload to include precision-guided weapons.

The Reaper logged almost 7,000 flying hours with one landing Class A, giving it a rate of 14.5 per 100,000 flying hours. Additionally, the Reaper encountered two Class C mishaps and one Class E miscellaneous event.

M/RQ-1

Year	Class A		Class B		Destroyed		Hours
	No.	Rate	No.	Rate	A/C	Rate	
FY07	5	6.3	0	0.00	3	3.79	79,177
5 YR AVG	4.2	9.13	0.2	0.43	3	6.52	45,978
10 YR AVG	3.2	11.78	0.3	1.1	2.5	9.2	27,159
LIFETIME FY94-FY07	34	12.4	3	1.09	27	9.85	274,249

RQ-4

Year	Class A		Class B		Destroyed		Hours
	No.	Rate	No.	Rate	A/C	Rate	
FY07	0	0.00	0	0.00	0	0.00	5,971.5
5 YR AVG	0.4	0.00	0.2	6.87	0	0.00	2,910.3
LIFETIME FY99-FY07	4	22.94	1	5.73	3	17.21	17,430

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

Others

USAF Photo by MSgt Edward Snyder

C-9

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	0	0.00	0	0.00	0	0.00	0	0	799
5 YR AVG	0.0	0.00	0.6	11.48	0.0	0.00	0.0	0.0	5,228.6
10 YR AVG	0.1	0.78	0.4	3.10	0.0	0.00	0.0	0.0	12,884.7
LIFETIME CY68-FY07	3	0.33	6	0.67	1	0.11	3	3	898,826

C-12

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	0	0.00	0	0.00	0	0.00	0	0	3,086
5 YR AVG	0.0	0.00	0.2	4.75	0.0	0.00	0.0	0.0	4,212.4
10 YR AVG	0.0	0.00	0.2	4.72	0.0	0.00	0.0	0.0	4,239.4
LIFETIME CY75-FY07	2	0.47	3	0.71	1	0.24	2	6	425,500

C-20

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	0	0.00	0	0.00	0	0.00	0	0	5,019
5 YR AVG	0.0	0.00	0.2	4.31	0.0	0.00	0.0	0.0	4,635.6
10 YR AVG	0.0	0.00	0.2	3.76	0.0	0.00	0.0	0.0	5,320.1
LIFETIME CY83-FY07	0	0.00	2	1.45	0	0.00	0	0	138,163

C-21

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	1	3.18	0	0.00	0	0.00	0	0	31,440
5 YR AVG	0.2	0.46	0.0	0.00	0.0	0.00	0.0	0.0	43,519.6
10 YR AVG	0.2	0.44	0.3	0.66	0.1	0.22	0.2	0.2	45,472.2
LIFETIME CY84-FY07	4	0.36	3	0.27	3	0.27	6	12	1,115,652

F-117

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	0	0.00	0	0.00	0	0.00	0	0	9,884
5 YR AVG	0.0	0.00	0.6	5.23	0.0	0.00	0.0	0.0	11,482.0
10 YR AVG	0.1	0.81	0.5	4.05	0.0	0.00	0.0	0.0	12,349.6
LIFETIME FY91-FY07	7	3.24	8	3.70	3	1.39	1	1	216,151

T-41

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	0	0.00	0	0.00	0	0.00	0	0	1,059
5 YR AVG	0	0.00	0	0.00	0	0.00	0	0	881
10 YR AVG	0	0.00	0	0.00	0	0.00	0	0	879
LIFETIME CY74-FY07	9	1.45	5	0.80	4	0.64	1	2	621,806

V-22

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	0	0.00	0	0.00	0	0.00	0	0	1,255
5 YR AVG	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.0	251.0
LIFETIME FY07	0	0.00	0	0.00	0	0.00	0	0	1,255

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

Helicopters

LT COL THOMAS ROY
HQ AFSC/SEFF
Kirtland AFB, NM

Fiscal Year (FY) 2007 was another exceptional year for U.S. Air Force helicopter mishap prevention. Most importantly, our community again experienced no fatalities or serious injuries during the fiscal year. USAF helicopters experienced 1 Class A mishap, 4 Class B mishaps, and 20 Class Cs during FY07; statistics very similar to last year. As in FY 2006, the 2007 mishaps were mixed between materiel failures and human factors showing no clear trends.

The HH-60 experienced no Class As, 2 Class Bs, and 7 Class C mishaps in FY07. The Class Bs resulted from a hard landing and a ground taxi operation blade strike. The first Class B of FY07 involved an aircraft executing a tactical takeoff during which the aircraft was unable to sustain flight, resulting in a hard landing on rocky, uneven terrain. The impact caused significant structural and component damage to the belly of the aircraft. The second Class B involved an alert aircraft taxiing for takeoff. The aircraft's main rotor blades struck a vehicle adjacent the taxiway damaging the main rotor blades, the vehicle, and an adjacent parked aircraft.

The MH-53 experienced 1 Class A, 1 Class B, and 3 Class C mishaps in FY07. The aircraft suffered a hard landing with the crew suffering minor injuries. The accident is still under investigation. The Class B involved engine damage during start. A crew chief noticed significant sparks shooting from the engine exhaust during the start sequence. The crew shut down the aircraft and returned it to maintenance. Initial inspections revealed substantial damage to the engine's compressor section.

The UH-1 series had no Class As, 1 Class B, and 6 Class C mishaps. The Class B resulted from a materiel failure within the combustor section of the engine during single-engine functional check flight operations. The resulting gas path and cooling flow disturbance seriously damaged components downstream resulting in engine failure. The crew successfully performed a single-engine run-on landing.

Congratulations on another great year for USAF helicopter safety. Keep up the great work, keep focusing 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	
FY07	0	0.00	0	0.00	0	0.00	0	0	26,952
5 YR AVG	0.0	0.00	0.6	2.50	0.0	0.00	0.0	0.0	23,971.0
10 YR AVG	0.3	1.38	0.3	1.38	0.3	1.38	0.0	0.0	21,713.8
LIFETIME CY59-FY07	54	3.13	17	0.98	40	2.52	21	52	1,727,825

H-53

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	1	12.55	0	0.00	0	0.00	0	0	7,970
5 YR AVG	1.2	12.71	1.6	16.95	0.4	4.24	0.2	1.0	9,438.8
10 YR AVG	1.3	11.31	1.6	13.92	0.4	3.48	0.1	0.6	11,498.3
LIFETIME CY66-FY07	39	7.57	31	6.02	23	4.47	25	86	515,099

H-60

Year	Class A		Class B		Destroyed		Fatal		Hours
	No.	Rate	No.	Rate	A/C	Rate	Pilot	All	
FY07	0	0.00	1	3.88	0	0.00	0	0	25,772
5 YR AVG	1.2	4.59	0.8	3.06	0.6	2.30	0.4	1.6	26,126.2
10 YR AVG	1.1	4.22	0.5	1.92	0.6	2.30	0.6	2.0	26,074.6
LIFETIME FY82-FY07	18	3.94	7	1.53	11	2.41	11	42	456,545

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

USAF Photo by SrA Andy M. Kin

Engines

BILL BRADFORD
Universal Technology Corp.
RICH GREENWOOD
Pratt & Whitney
BOB WOLFF
General Electric

This year continued a good trend in engine-related mishaps in the USAF. Last year the percentage of engine-related destroyed aircraft as compared to the total number of destroyed aircraft (3 to 8) was 37.5%, while this year that same comparison was 21.4% (3 to 14) (see Figures 1 and 2). We had the same number of engine-related mishaps, but a lower percentage due to

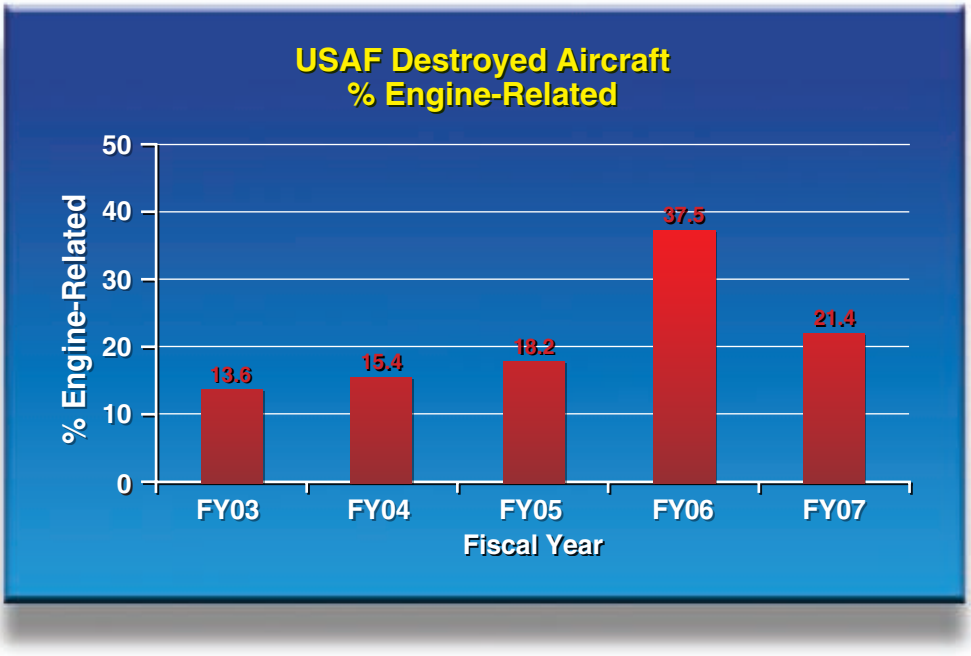


Figure 1

USAF Photo by Daryl Cooper

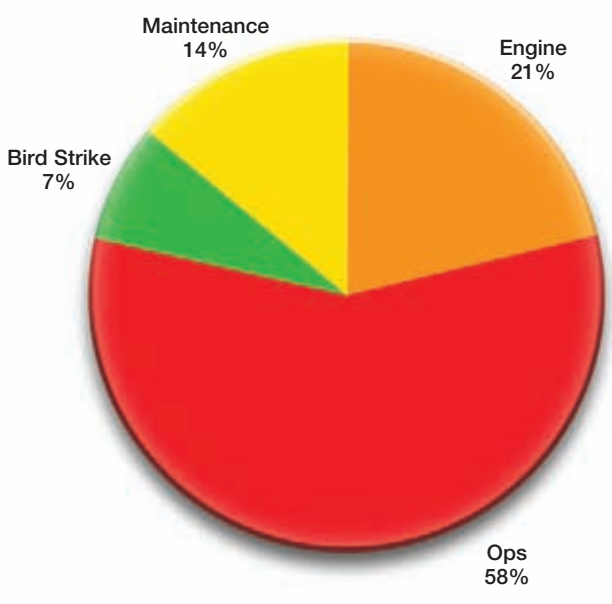


Figure 2

a larger number of total mishaps. It's not so much that engines improved, but that we had more mishaps due to other causes, primarily Operations. They were all single-engine aircraft, and only one of the three was a known failure mode. While having new failure modes is not necessarily a good thing, repeat failures are a sign that current risk mitigation measures are likely inadequate.

In addition to the 3 destroyed aircraft, there were 4 engine-related dollar value Class A mishaps in FY07. This brings the total number of engine-related Class A mishaps to 7 in FY07, versus 6 in FY06. While this is obviously not an improvement, statistically speaking, we are still tracking very closely to last year's performance.

Looking at our 7 engine-related Class A mishaps this past fiscal year by engine section (see Figure 3), it shows a remarkably even distribution of "problem areas." The section that is noticeably absent, especially as compared to previous years, is the turbine. Could the risk mitigation established previously have had something to do with its absence? I believe the answer to that question is affirmative!

FY07 Engine-Related Class A Flight Mishaps By Engine Section

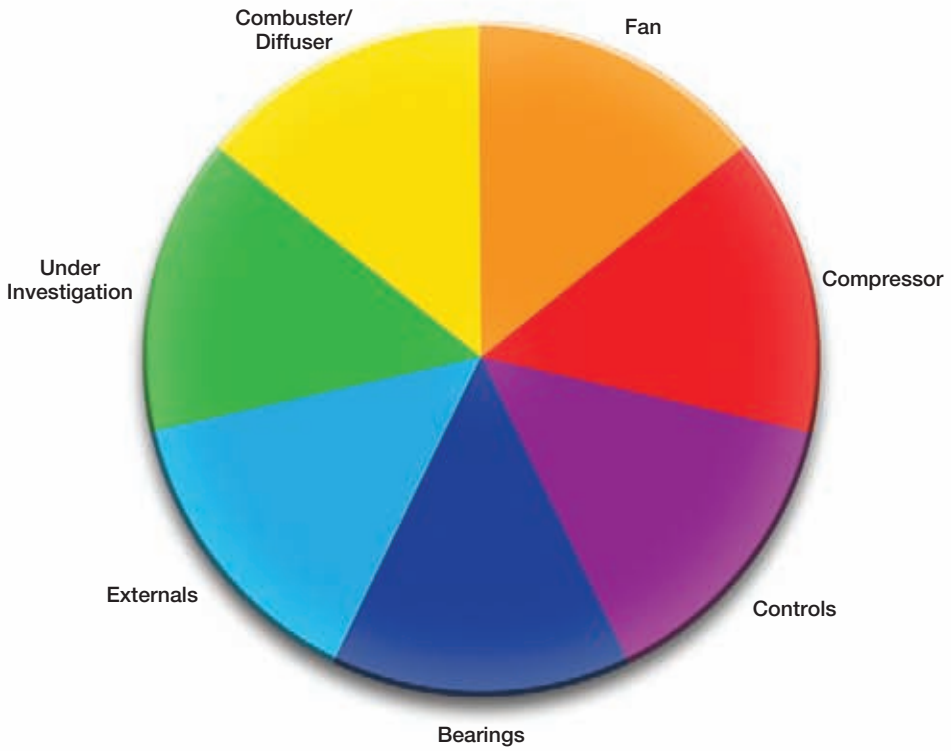


Figure 3

The Fighter Factor

Each year we typically show both F-16 and F-15 Class A flight mishap statistics and compare them to the engine-related Class A statistics. For the F-16 we had a total of 11 Class A mishaps in FY07, with 5 of them being caused by the engine (see Figure 4). As compared to the four previous years, this was not an exceptionally great year for the F-16 engine community. We will address each of these engine-related Class A mishaps in subsequent paragraphs.

Table 1 depicts the F-16 engine-related destroyed aircraft by engine model and their mishap rates per 100,000 flight hours for the last three fiscal years. From this table, it is obvious that the F100-PW-220 had a particularly tough year as compared to other F-16 engine models as well as compared previous years.

The engines powering the F-15 had an exceptional year in FY07. They were responsible for zero destroyed F-15 A/C (see Table 2), falling back into

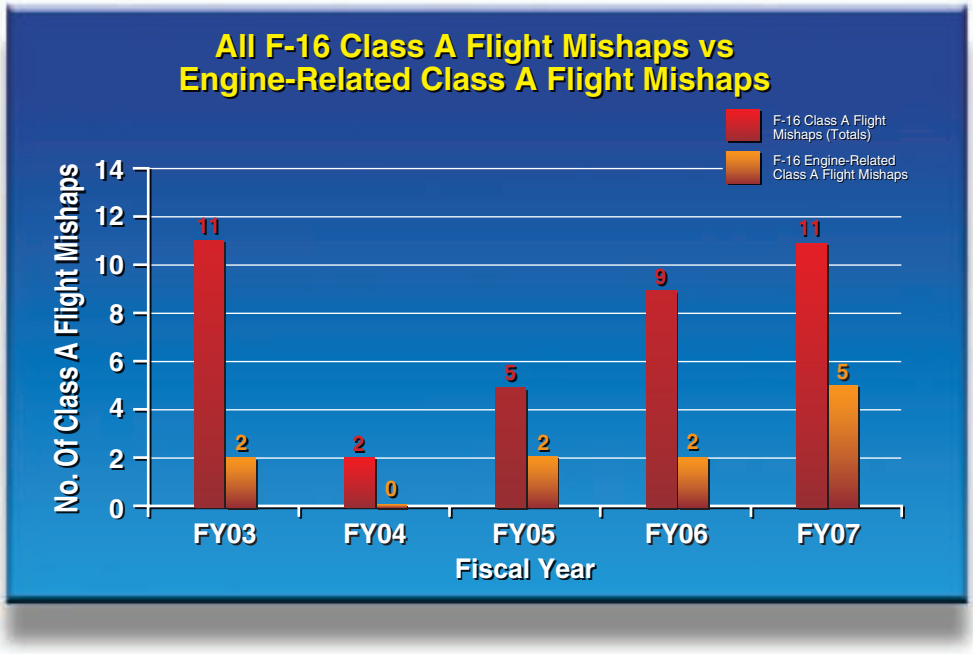


Figure 4

USAF Photo by MSgt Michael Chambers

the "rut" they've enjoyed in many years previous to FY06. Additionally, there were no engine-related Class A flight mishaps overall for the F-15 A/C (see Figure 5) in FY07.

F-16/F100-PW-220 Mishaps–3rd Fan Disk Fracture

The mishap aircraft (MA) was lead of a two-ship afterburner formation takeoff Basic Fighter Maneuver sortie. Shortly after selecting afterburner for takeoff, the MA experienced an engine explosion followed by a fire. The mishap pilot (MP) aborted on the runway and ground egressed from the MA. The MA sustained significant damage and was declared a total loss valued at approximately $22 million.

The cause of the mishap was traced to a rupture of the 3rd stage fan disk. A small region of distorted microstructure of the disk material was found near one of the disk bolt holes. The distorted microstructure eventually led to a fatigue crack from the bolt hole and rupture of the disk. As the pieces of the disk exited the airframe, they penetrated the fuel tank and ignited a fire. The fuel-fed fire damaged the engine and aft portion of the airframe.

Subsequent investigation revealed the area of distorted microstructure was most likely caused by an overly aggressive disassembly process used during a previous overhaul cycle of the disk. This process was discontinued in late 2003. A population of 52 other disks disassembled in the same time frame as the mishap engine disk was located (43 in F-15s and 9 in F-16s), and TCTOs issued to remove them from service at appropriate time intervals.

Diffuser Case Fracture

The F-16 MP and the Mishap Instructor Pilot (MIP) were on a Surface Attack profile and had just completed multiple high altitude bombing

F-16

F-16 Engine-Related Destroyed Aircraft Statistics

Fiscal Year	FY05		FY06		FY07	
Engine	Aircraft Losses	FY05 Rate	Aircraft Losses	FY06 Rate	Aircraft Losses	FY07 Rate
F100-PW-220	0	0.00	1	0.94	3	2.81
F100-PW-229	0	0.00	0	0.00	0	0.00
F110-GE-100	1	0.73	1	0.68	0	0.00
F110-GE-129	1	2.19	0	0.00	0	0.00
All Engines	2	0.63	2	0.62	3	0.92

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

Table 1

F-15

F-15 Engine-Related Destroyed Aircraft Statistics						
Fiscal Year	FY05		FY06		FY07	
Engine	Aircraft Losses	FY05 Rate	Aircraft Losses	FY06 Rate	Aircraft Losses	FY07 Rate
F100-PW-100	0	0.00	0	0.00	0	0.00
F100-PW-220	0	0.00	1	0.60	0	0.00
F100-PW-229	0	0.00	0	0.00	0	0.00
All Engines	0	0.00	1	0.32	0	0.00

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

Table 2

patterns. While setting up for low altitude bombing patterns, the Mishap Crew (MC) heard a loud bang and experienced decreasing thrust. The MC turned towards an auxiliary airfield, informed the lead aircraft over the radio that they had an engine problem, and attempted two engine restarts.

The MC, having confirmed that the engine was unresponsive and recognizing that the MA was at too low an altitude to make it to the auxiliary field, safely ejected and sustained no injuries. The MA was destroyed on impact with a loss valued at approximately $21 million. The MA impacted on government property.

Through post-crash analysis, it was determined that the engine's diffuser case ruptured due to a fatigue crack in the upper side of the weld on the combined AP4/igniter boss on the right hand side of the engine. The ruptured case dumped all the combustor air from the core and the engine flamed out, resulting in a non-recoverable in-flight shutdown. Unfortunately, this mishap was almost identical to one that occurred 6 months previously with an F-16 of a foreign country. The analysis as to the impact on the US fleet of this mishap was still under investigation at the time of the crash. TCTOs 2J-F100(II)-708, 708C and 708D were issued to remove suspect diffuser cases from the F-16 fleet. Suspect F-15 diffuser cases are being inspected on a periodic basis.

The cracks in the welds initiated in high stress regions are caused by the angular displacement between the boss and the skirt of the case. Over time, the high stresses lead to cracking and eventual rupture of the case. The inspections in place at the time the cases were overhauled were insufficient to detect these very small and tight cracks during the overhaul process. The problem was isolated to older style diffuser cases manufactured in the early 1980s with thin-walled skirts. Locations of these cases were identified and a plan instituted to inspect and remove them at appropriate intervals to maintain fleet risk below established thresholds.

Fuel Manifold Leak

The MF briefed as a five-ship red air support mission of F-16s. The MP was number 5 and accomplished a normal augmenter takeoff. Departure and climb to cruise altitude were uneventful. Just over 10 minutes after takeoff, the MP maneuvered MA and reduced his throttle setting to maintain his position behind the flight. As he pushed the throttle forward, he felt no response from the engine. After determining the engine had flamed out, the MP made 2 restart attempts, both of which were unsuccessful. The MP successfully ejected at approximately 2,900 ft AGL without injury. The MA glided 1 minute longer before it was destroyed

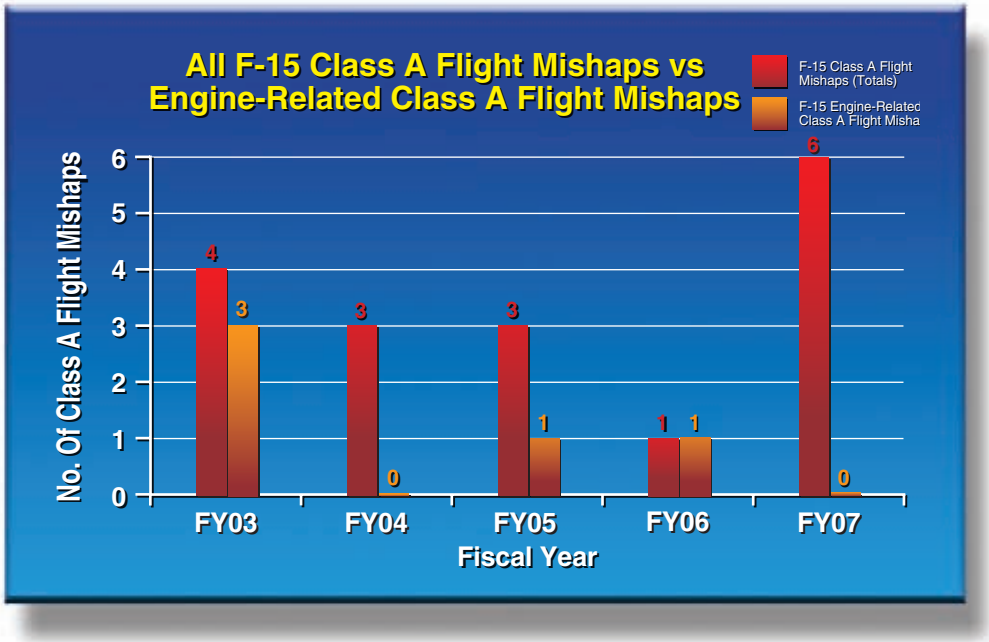


Figure 5

USAF Photo

upon impact. SAR forces were dispatched, and the MP was successfully recovered and transported to a local hospital where he was treated and released.

Investigation revealed that the flange bolts connecting a fuel line from the main fuel control to the engine were loose, allowing the flange to leak fuel. Loss of fuel to the engine caused it to flame out. The AIB determined that improper maintenance procedures during a previous replacement of the engine's fuel/oil cooler resulted in the flange bolts not being properly torqued. Fuel/oil cooler replacement procedures in the Tech Orders are being revised to emphasize proper procedure for replacement of the fuel/oil cooler.

Departure-Induced Stagnation

The mishap sortie was a single-ship USAF Test Pilot School (TPS) high angle-of-attack (AoA) data collection sortie. The MC consisted of a student test pilot (MP) in the front seat and a test pilot school instructor pilot (MIP) in the rear seat. Brief, start, taxi, takeoff, and departure were uneventful. During one of the maneuvers, a roll-coupled departure, the MIP noted several compressor stalls. Following the stalls, the engine was checked for normal operation and the sortie was continued. The next maneuver was a slow-down turn demonstration by the MIP to demonstrate yaw departure characteristics of the F-16B. During this maneuver, the MA departed in yaw and settled into an upright deep stall. During the initial departure, the MIP again noted compressor stalls, along with a secondary engine control (SEC) caution light. The MA self-recovered from the deep stall and the MIP initiated a turn towards high key. While enroute, the MIP noted an engine warning light, sub-IDLE engine RPM, and FTIT readings of zero. Two airstart attempts were made, which were unsuccessful. The MIP continued to fly a successful flameout approach and landed on the active runway. Post-flight analysis showed significant damage to the engine turbine section.

The USAF TPS flies "non-standard" mission profiles, which can consist of several high-altitude departure-induced events per sortie. These departures can induce high yaw angles and AoA which subject the engine inlet to airflow distortions, leading to disruption of the normal flow of air to the engine. This sometimes results in engine stalls. The TPS has specific non-Dash One procedures in place for when these stalls occur. Instead of immediately landing to troubleshoot the stall, they are allowed to continue the mission if they can verify normal engine operation.

In rare instances, as occurred here, the stall can become non-recoverable, requiring the engine throttle to be placed in cut-off and an airstart performed. If this is not done quickly enough, overtemperature damage can occur to the turbine section of the engine. If this damage is severe enough, the engine will not be restartable. This is what occurred in this instance.

C-17/F117 Mishap–Compressor Damage

During normal VFR pattern operations, the MC heard a loud bang, felt a slight right yaw of the aircraft and an engine shudder emanating from the number 3 engine. The tower controller told the crew that there appeared to be a large spark (with trailing smoke) from the right wing. These events were followed by an uncommanded engine shutdown of the number 3 engine. The MC landed the MA safely, taxied to parking, and turned the MA over to maintenance.

Teardown investigation of the engine revealed that one set of 10th stage compressor blade gang locks had fractured, resulting in extensive high compressor damage and a non-recoverable in-flight shutdown. Fracture of the ganglocks is a known problem that is addressed by Service Bulletin (SB) 72-259. This SB requires replacement of the gang locks with an improved design "when subassembly (i.e., modules, accessories, components, build groups) is disassembled sufficiently to afford access to the affected part and to all affected spare parts." (Production incorporation of the new blade locks became effective in June 1998.) Although sections of the ME compressor had been disassembled for a performance restoration shop visit in January of 2004, the 10th stage compressor area was not disassembled, hence the gang locks were not replaced. The 10th stage gang locks were to be replaced with the improved individual blade locks during the next Heavy Maintenance shop visit.

A risk assessment is currently being performed to determine if a more aggressive gang lock replacement schedule is required to keep fleet risk below established thresholds.

KC-10/F103-GE-101 Mishap—Number 4 Bearing

While enroute to a deployed location, the crew noted an oil pressure fluctuation on the number 3 engine. Shortly thereafter, the oil temperature began to rise, accompanied by zero oil quantity indication. In accordance with flight manual procedures, the crew shut the engine down and returned to base. Post-flight inspection revealed internal engine damage, requiring the engine to be removed. The ensuing teardown and technical analysis of the engine pointed to the cause of the mishap. The number 4 bearing was damaged as a result of gross frictional overheating caused by a partially obstructed oil nozzle orifice. At an unknown time and from an unknown source, a foreign object entered the oil system. This foreign object obstructed the orifice to the number 4 ball bearing nozzle, restricting the flow of oil and cooling lubrication to the number 4 ball bearing.

F-16/F110-GE-100 Mishap

After experiencing an engine anomaly, the pilot declared an in-flight emergency and returned to base. The pilot caught the cable after landing, after which a fire was observed in the engine inlet. The pilot safely egressed the aircraft and responding emergency personnel extinguished the fire. At the time of this writing, the safety investigation for this mishap was ongoing.

Maintenance

USAF Photo by MSgt Michael R. Nixon

CMSGT SANDY STACY
HQ AFSC/SEFO
Kirtland AFB, NM

Listen up Maintainers! It's that time of the year where we get our Safety Report Card. How do you think we did? Did you do your part? Did you always follow tech data? Did you wear your PPE? Did you document maintenance performed? If you answered yes to these questions, then I salute you! If you're one of the many that didn't do the above, why didn't you?

I'll be the first to tell you I know how hard it is to balance performing quality maintenance with the pressures of turning aircraft or parts, but that's exactly what I'm asking you to do. Have you ever walked out to your aircraft or to your workstation and remembered that you forgot your torque wrench? What did you do, use your "calibrated" arm or go back to the tool crib to get the wrench? The right answer of course was to go get the correct tool, but unfortunately too many of us chose the "easy" way, and this year we damaged two aircraft for failing to torque parts correctly. Maintainers everywhere need to realize that failing to use the proper tool, document forms, and follow checklists and tech data causes damage to aircraft.

In the following paragraphs I'll provide examples of how our failing to follow the rules has cost the Air Force money, destroyed aircraft, and given ourselves a lot of extra work. In FY07 our Class A and B mishaps increased from FY06 rates; however, you've done a great job decreasing our Class Cs this year.

Class A Mishaps

• The engine flamed out and the aircraft crashed. While performing maintenance on the engine, the fuel oil cooler bolts were loosened, not written up, and not re-torqued. The result … total aircraft loss … $20.7M.

• The throttle quit responding during flight, and the aircraft crashed trying to land. Either during installation or other maintenance, the throttle cable became kinked and ultimately broke. The result … total aircraft loss … $29.2M.

• The nose landing gear tire blew during takeoff roll. During installation of the nose landing gear tire, the tire pressure was incorrectly inflated. The result … total aircraft loss … $24M.

• While taxiing to a parking spot, the left wingtip struck a blast fence. Supervision failed to ensure the parking spot was adequate for this aircraft (it wasn't), and the wing walker failed to notify the tow super of insufficient clearance between the wing and the fence. The result … $1M in damage.

Class B Mishaps

• The #2 engine was FOD'd out by the water intrusion plug. This is a repeat from last year. During pre-flight, the maintainer did not follow tech data for removal of the plugs and left one installed. The result … $397K in damage.

• During flight, the #4 engine LPT liberated through the engine case. During maintenance, shroud segments were not installed. The result … $871K in damage.

USAF Photo by SSgt Jeanette Copeland

• Maintenance found 2 damaged blades in the 10th stage compressor. Seems during maintenance, someone left FO in the inlet and then failed to find it during the inlet inspection. The result … $209K in damage.

• During flight, the right pylon, CAP-9, and external fuel tank departed the aircraft. When the pylon was attached, a cannon plug was incorrectly installed and bent a pin. The result … $284K in damage.

• During an intake inspection, damage was found to the #1 engine. A fastener from panel 27L was ingested into the engine. It was the wrong type of fastener. The result … $374K in damage.

Class C Mishaps

Our Class C maintenance mishaps were the lowest in 8 years: only 24. We've damaged fighters, tankers, cargo carriers, and an E-3. Even though the list is shorter than last year, it's still too long to quote every mishap. So here's a synopsis of what went wrong on the flightline and in the shops:

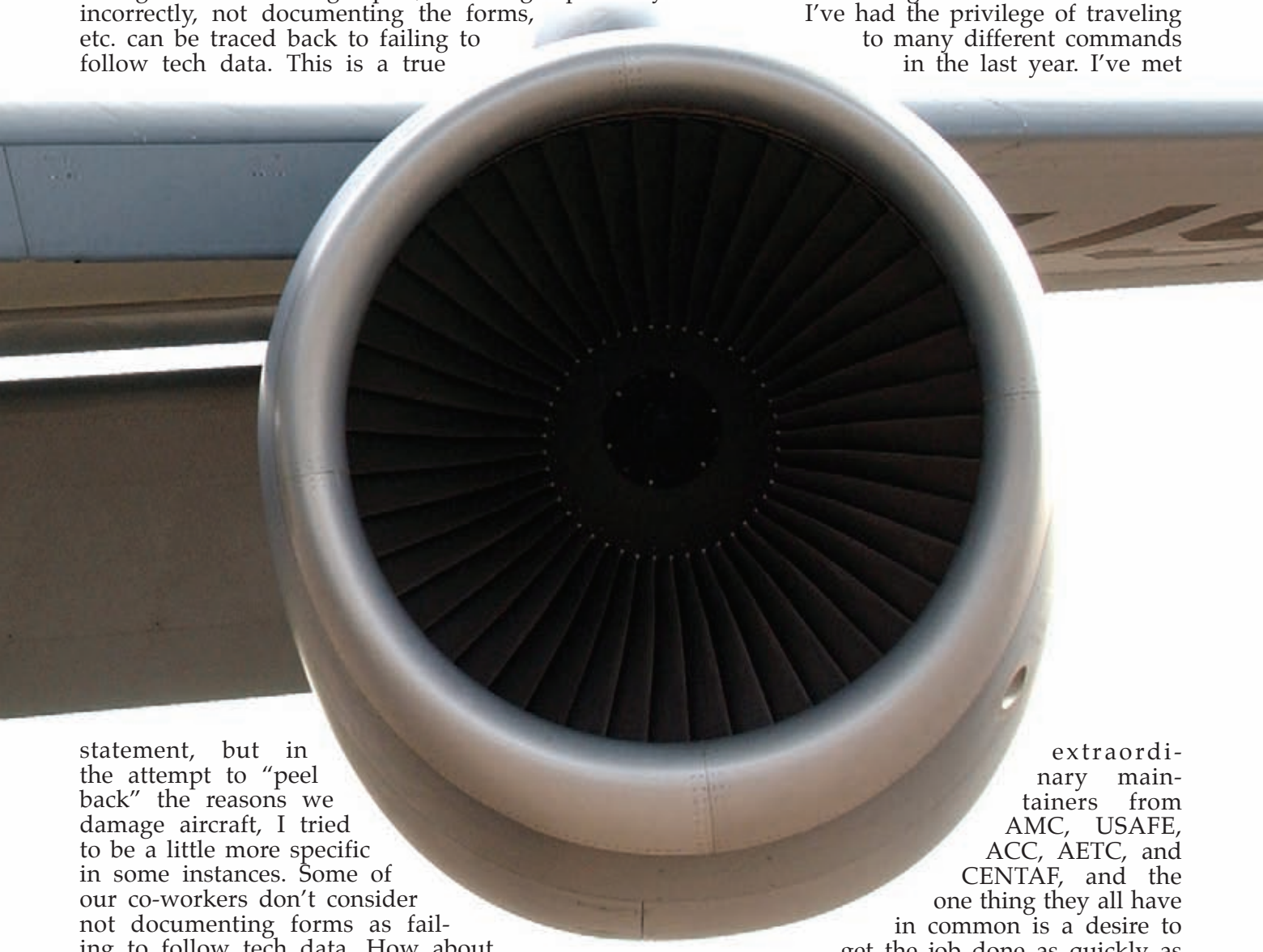
- 1 instance of equipment being ingested … inlet plug
- 1 instance of not installing parts … spacers
- 1 FOD … fasteners and nutplates
- 1 time attention to detail got us … rivet too loose
- 1 occasion where supervision accepted the risk of modifying a parking plan in the AOR and didn't follow AFI guidance … wingtip damage
- 1 occurrence of not documenting forms … bleed air clamp removed
- 2 cases of improperly installing parts … engine cowling and cannon plug
- 5 cases of the wrong part being installed … fasteners (twice), wheel bearings (twice), and bolts

This year's #1 cause of Class C mishaps? We failed to follow tech data 11 times! We've got an interesting collection of "failure to do's" this year. We failed to route a canopy safety cable correctly; we failed to correct previous discrepancies IAW

tech data, which led to one last discrepancy that caused a mishap; we've over-torqued; installed backwards; failed to secure; incorrectly rigged; and even failed to clamp a line correctly.

Summary

Every maintainer reading this will say that failing to install the right part, installing a part incorrectly, not documenting the forms, etc. can be traced back to failing to follow tech data. This is a true statement, but in the attempt to "peel back" the reasons we damage aircraft, I tried to be a little more specific in some instances. Some of our co-workers don't consider not documenting forms as failing to follow tech data. How about TO 00-20-1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures*? That's tech data.



I've heard from flightline maintainers that they'd never get the job done if they followed the AFIs, TOs, and local guidance. Why not? Is the guidance incomplete? Is it too complicated? Are there too many steps? If it's incomplete, submit a change. If it's too complicated, maybe you should read it through enough times so that you understand each and every step. If there are too many steps and it takes a long time to read them while doing the maintenance, then have someone else (your trainee or your supervisor?) read them, as you do the work. I challenge all of you to do these three things and see if it really does take longer to follow the book. Or do you really enjoy constantly looking over your shoulder to see if QA or the OIC or Chief is watching what you're doing? Or sweating it out when an aircraft crashes and you worked on it the night before?

I've had the privilege of traveling to many different commands in the last year. I've met extraordinary maintainers from AMC, USAFE, ACC, AETC, and CENTAF, and the one thing they all have in common is a desire to get the job done as quickly as possible to get the aircraft in the air. They all agree doing the job right and safely are the most important missions they have, and yet last year, we caused over $80 million in damage to aircraft. If you're a supervisor, ensure your people are trained, have the right equipment, and know you'll only accept tech data compliance. If you're the lowest ranking Airman in the shop, make sure you know the right way to do the job and if not, keep asking your supervisor to train you until you're comfortable with the job. Sometimes it takes the newest person to see a better way to accomplish the mission. Use your voice!

Human Factors

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Of the 35 Class A aviation mishaps involving unmanned aerial vehicles and manned aircraft in FY07, 22 were coded with DoD Human Factors Analysis and Classification System (DoD HFACS) codes (these numbers include all aviation mishaps—rate and non-rate producing). Of the 12 mishaps not coded, 5 were bird strikes, 7 were power plant-related and 1 was a mechanical failure. The investigation boards for these mishaps did not identify human factors involved, because they were not evident or present in the mishap. The DoD HFACS was accepted as the DoD Human Factors Taxonomy by the U.S. Armed Services Safety Chiefs in a Memorandum of Agreement (MOA) on 10 May 05. Since this time, the U.S. Air Force has been using this taxonomy for mishap investigation; however, FY07 is the first year this taxonomy was used for all Class A aviation mishaps. The increased benefit of DoD HFACS over the previous legacy human factors taxonomy is that it allows us to look at not just individual human failures, but the failures in the systems that humans design, build, operate, and maintain. DoD HFACS, as opposed to the legacy human factors taxonomy, is organized in a more systemic format which allows easier identification of relationships between factors.

Looking at the top-level tier of DoD HFACS, Organizational Influences, FY07 saw Procedural Guidance/Publications, Acquisition Policies/Design Processes, and Organizational Training Issues as the highest reported codes. Procedural Guidance/Publications was present in 13 of the 22 coded mishaps (59 percent). Organizational Training Issues was cited in 5 mishaps, and Acquisition Policies/Design Processes was cited in 5 mishaps. Procedure Guidance/Publications was also cited in 4 of the 5 mishaps which cited Organizational Training Issues and 4 of the 5 mishaps which cited Acquisition Policies/Design Processes. For

USAF Photo by MSgt Cesar Rodriguez

example, one mishap involving a dropped object due to hatch not being closed securely cited the latch design, written procedures for securing the latch, and maintenance training issues as factors in the mishap. These three organizational tier codes each contributed to the mishap; not just one was the exclusive cause of the mishap. Additionally of interest, Procedural Guidance/Publications was cited in 88 of 179 mishaps (50 percent) between FY02 and FY07.

At the Supervisory tier, no one code was present in a significant number of mishaps. When combining the 5 mishaps which cited Organizational Training Issues/Programs and 2 separate mishaps which cited Local Training Issues/Programs, a total of 6 mishaps cited training issues as a factor in the mishap (one mishap cited both Organizational and Local Training). More telling is Local Training Issues which was cited in 4 mishaps in FY06 and 30 mishaps from FY02 to FY06. On the positive side, the presence of Limited Total Experience and Proficiency in Class A aviation mishaps had been reduced. Limited Total Experience was present in 19 mishaps from FY02 to FY05 and no mishaps in FY06 and FY07. Proficiency was present in 15 mishaps from FY02 to FY05, none in FY06, and 1 mishap in FY07. It is rewarding to see this positive trend.

The Preconditions of Individuals Tier is the most complex tier and includes Environmental Factors, Perceptual Factors, and Conditions of the Individual. These are conditions which should be recognized and managed properly. When they are not managed properly, they are often present in a mishap chain. Cognitive Factors continue to be present in Class A mishaps. In total, Cognitive Factors was present in 11 of the 22 coded mishaps (50 percent). Channelized Attention, Cognitive Task Oversaturation and/or Confusion were present most often. The only relationship identified between the Cognitive Factors was between Channelized

Attention and Cognitive Task Oversaturation. Of the 6 mishaps which coded Channelized Attention, Cognitive Task Oversaturation was cited in 3 of these mishaps. Other than the Cognitive Factors, the most prevalent Preconditions codes for FY07 were codes for fatigue and perceptual factors. Fatigue-Physiological/Mental was cited in 4 mishaps, Circadian Rhythm in 3 mishaps, and Inadequate Rest in 2 mishaps. All told, fatigue was present in 5 of the 22 coded mishaps (or 23 percent). A Judgment and/or Decision Making Error was the resultant act in all 5 fatigue-related mishaps. It has long been known that sleep deprivation produces deficits in elementary cognitive processes such as alertness, attention, concentration, and psychomotor vigilance. However, recent interest has been more specifically focused on how sleep loss may affect higher order cognitive processes such as judgment, decision making, and cognitive control. These types of cognitive processes rely heavily on the functional integrity of the prefrontal cortex. Twenty-four hours of continuous sleep deprivation is associated with significant reductions in metabolic activity within the prefrontal cortex. (*Aviation, Space and Environmental Medicine, October 2007, Volume 78, Issue 10*). Of the Perceptual Factors, Misperception of Operational Conditions was listed in 4 mishaps and Expectancy was listed in 4 mishaps. Of the mishaps which included Misperception of Operational Conditions, 3 resulted in a Judgment and/or Decision Making Error. On the up side, Task Delegation and Mission Planning were not reported in a single mishap in FY06 or FY07; however, they were reported 30 and 14 times respectively from FY02 to FY05.

The final tier, Acts, describes active failures or actions committed by the operator that result in human error or unsafe situation. Based on the DoD HFACS model, Acts is generally the result of a string of factors from the top three tiers. When an organization fails to implement controls, and these failed controls allow a hazard to progress through the top three layers, the theoretical result is an Act which results in a mishap. Of the 22 coded mishaps, 12 (or 55 percent) resulted in a Judgment and/or Decision Making Error. Of these 12 mishaps, 6 also included a Skill-Based Error, 2 included an Error due to Misperception, and 1 included a Violation. There were 3 mishaps with a Skill-Based Error that did not also include a Judgment and/or Decision Making Error. Of the 12 mishaps which included a Judgment and/or Decision Making Error, 6 (or 50 percent) also cited Procedural Guidance/Publications as a factor. Of the Judgment and/or Decision Making Errors, Risk Assessment-During Operation and Decision Making-During Operation continue to be the high tally codes with 4 and 6 in FY07, and 9 and 5 in FY06, respectively. In the Violations category, it is disturbing to see a Lack of Discipline Violation coded for 2 mishaps in FY07 and 3 mishaps in FY06 with a total of 23 for FY02-07. A Lack of Discipline Violation is defined as a factor when an individual, crew, or team intentionally violates procedures or policies without cause or need. These violations are unusual or isolated to specific individuals rather than larger groups. There is no evidence of these violations being condoned by leadership. These violations may also be referred to as "exceptional violations." On the positive side, however, Necessary Action-Rushed was cited 26 times from FY02-05 and once in FY07.

In conclusion, FY07 Class A aviation mishaps continued to see the presence of Procedural Guidance/Publications and Training Issues. Publications will never be perfect, but we need to increase our vigilance on procedural guidance and ensure we are writing logical and meaningful requirements. Human Fatigue continues to be cited in Class A aviation mishaps, and when present, resulted in a Judgment and/or Decision Making Error. Not only did we see Fatigue in 23 percent of the Class A mishaps this past fiscal year, but it was also present in 21 percent of the Class A mishaps in FY06. Not only do aircrew need to be aware of proper fatigue management and countermeasures, but schedulers, and most importantly, leadership need to be aware of and recognize the hazards of fatigue. Cognitive Factors was present in 11 mishaps with Channelized Attention, Cognitive Task Oversaturation, and/or Confusion being cited most often. Judgment and/or Decision Making Errors was present in 55 percent of the Aviation Class A mishaps with Risk Assessment-During Operation and Decision Making-During Operation being the most prevalent. Increased understanding of these factors can help mitigate them from future accidents. Understanding Cognitive Factors and how they can impact your flight profile or situations where Judgment and/or Decision Making may increase risk can help mitigate these factors in a mishap. The principles of Crew Resource Management are important principles to know and implement. Lastly, there was a decrease in the number of mishaps reported with Limited Total Experience, Proficiency, Task Delegation, Mission Planning, and Necessary Action-Rushed. Continue the positive trend in these areas and let's focus increased energy on Procedural Guidance, Fatigue, and those situations that increase threat and errors of Cognitive Factors and Judgment and/or Decision Making.

NOTE: Discussion of Human Factors codes identified in mishaps prior to FY07 only include those Human Factors codes rated as Casual or Major. Discussion of DoD HFACS codes in FY07 include all codes identified in the mishap. Definitions for DoD HFACS codes are available at http://afsafety.af.mil/SEF/Downloads/hfacs.pdf. As of 22 Oct 07, four mishaps (110524, 481479, 503979, 564009) have not been coded.

FY08 Aircraft Flight Mishaps
(Oct 07 - Dec 07)

3 Class A Aircraft Flight Mishaps
0 Fatalities
3 Aircraft Destroyed

FY07 Aircraft Flight Mishaps
(Oct 06 - Dec 06)

3 Class A Aircraft Flight Mishaps
1 Fatality
2 Aircraft Destroyed

Flight Rate Producing

01 Nov F-22A No. 2 engine FOD discovered during post-flight walkaround
02 Nov F-15C ✈ Crashed on training mission: pilot suffered minor injuries
28 Nov T-6A ✈ Dual T-6 midair collision

- A Class "A" aircraft 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 crew members successfully ejected/egressed from their aircraft.
- Reflects all fatalities associated with USAF Aviation category mishaps.
- "✈" Denotes a destroyed aircraft.
- Air Force safety statistics may be viewed at the following web address:http://afsafety.af.mil/stats/f_stats.asp
- **If a mishap is not a destroyed aircraft or fatality, it is only listed after the investigation has been finalized. (As of 19 December 07).**