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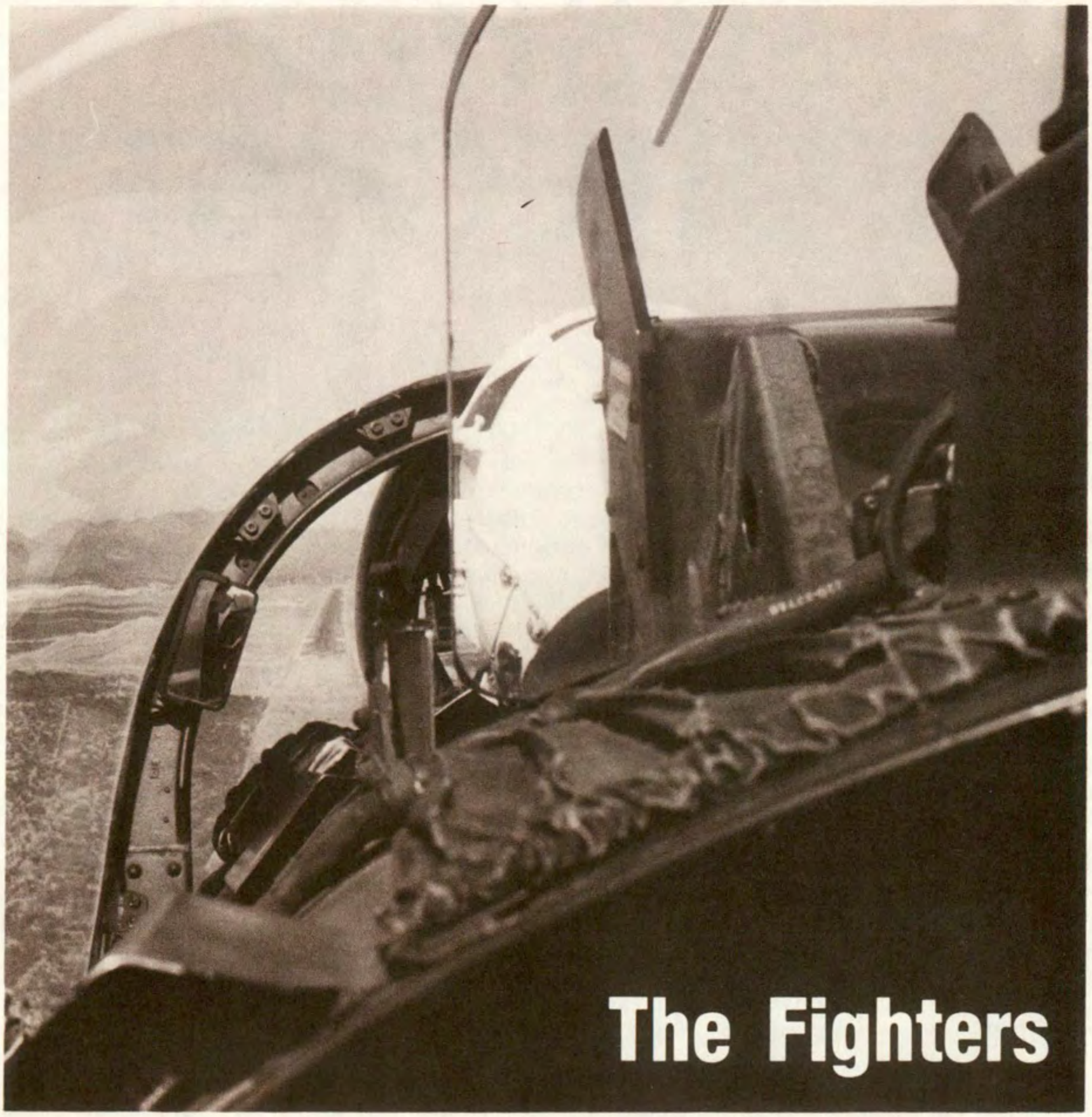
SAFETY

MARCH 1985

1985 FLIGHT MISHAP FORECAST



1985 FLIGHT MISHAP FORECAST

LT COL JAMES I. MIHOLICK
Directorate of Aerospace Safety

■ The 1985 flight mishap forecast predicts that the Air Force will have 63 Class A mishaps, 62 destroyed aircraft, and 19 Class B mishaps this year. Of the 63 Class As, 40 will be operations related (pilot error), 20 will be logistics related (materiel failure), and 3 will be miscellaneous or undetermined.

Fighter/attack aircraft will have 28 of the 40 operations Class As, 16 of the 20 logistics Class As, and 1 of the 3 miscellaneous or undetermined Class As. Of the 45 total fighter/attack Class As, 26 will involve F-4s and F-16s. These are some of the events that will happen this year *if* the 1985 flight mishap forecast is correct.

The forecast is, like its predecessors, only a reflection of the mishap potential that currently exists in the way we support, maintain, and operate our aircraft. It is based on three basic assumptions: (1) That we have accurately defined the types of mishaps our aircraft are likely to have, (2) that we have accurately assessed current trends, and (3) that nothing changes in the way we support, maintain, and operate our aircraft in terms of policy, procedures, tactics, modifications, etc. It also presupposes that we actually fly the 3,473,560 flying hours programmed for 1985.

In spite of some past accusations, the mishap forecast is not derived by a room full of fortunetellers with crystal balls, nor is it totally computer generated. It is, rather, the product of a logical process which begins with a computer generated expression of mishap potential based on the mishap history of each aircraft.

Historical mishap data are biased as a function of recency; i.e., the more recent the data, the more "weight" it is given. The weight given recent history is further biased for the aircraft's age, as newer aircraft are still on the exponential part of their historical mishap rate curve and do not yet exhibit the rate "stability" of older aircraft.

The weighted, projected cumulative rate for each aircraft for each type mishap is next compared to its 1985 programmed flying hours, and the product of these two numbers becomes the initial mishap projection for that aircraft. This is the only purely mathematical part of the process and involves some 10,575 separate calculations (47 aircraft x 25 mishap types x 3 sample time periods x 3 mishap classes).

The next step in the process involves evaluating Class C mishap and Category I materiel deficiency report trends for their reflection of mishap potential. If specific aircraft system trends are changing, the mathematical projection is further

continued on page 2

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SPECIAL ISSUE

Last year was the best year in Air Force history in terms of numbers of fighter and attack mishaps. We also had the second best year ever overall, missing a new record by a small margin.

Although the 1984 fighter/attack mishap rate was the lowest in USAF history, it still accounts for over 70 percent of the total Class A mishaps. We need to look at these numbers to see what they really mean.

In this issue, we take a look at how we did in 1984 in our fighter, attack, and trainer aircraft. We will cover the heavies in April. This issue also contains the 1985 Aircraft Mishap Forecast. This is not a goal or a preordained chain of circumstance. We can act to improve our chances and better the record in 1985.

REGULAR FEATURES

DEPARTMENT OF THE AIR FORCE • THE INSPECTOR GENERAL, USAF

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biased accordingly. At this point, the last step in the process begins (the "slight-of-hand, mirrors, and Body English" step).

Air Force Inspection and Safety Center analysts and aircraft project officers get together and "murder" the projection for each aircraft based on their knowledge of current or anticipated changes in procedures, tactics, missions, restrictions, training programs, and the impact on mishap potential of any ongoing or anticipated aircraft modifications. Only after all of this is accomplished are the forecasts for each aircraft added to arrive at the Air Force total.

The overriding assumption on which the forecast is based is that nothing unforeseen changes. The inevitability of the forecast is totally dependent on that assumption being correct. If something changes to increase mishap potential, the numbers in that area will increase, and if something changes to decrease potential, they will decrease. We know that something changed in 1983 to lower mishap potential over the past 2 years, and this has been taken into account.

The 1985 forecast predicts fewer mishaps than any previous forecast. It also represents the largest annual decrease in the numbers predicted. This acknowledgement is still tempered by 1982 experience, but indicates that the changes seen in 1983 and 1984 reflect a new rate threshold which will continue into 1985.

Remember, the forecast is not a goal. The goal is to beat the forecast by additional prevention efforts in those areas it shows as having high mishap potential. The charts show us where we need to concentrate. The challenge now becomes finding a way to reestablish another downward trend in the Class A mishap rate. ■

FIGURE 1.
1985 FLIGHT MISHAP FORECAST BY TYPE MISHAP

Type Mishap	Number Destroyed	Class A Mishaps	Class B Mishaps
Control Loss	9	9	
Collision w/Ground	13	13	
Range	4	4	
Midairs	9	6	
Landing (Pilot)	4	5	3
Takeoff (Pilot)		1	
Ops Other	2	2	1
Ops Total	**41**	**40**	**4**
Flight Controls	2	2	
Landing Gear		2	2
Fuel System	2	2	
Engine	12	12	7
Engine FOD			1
Hydraulic/Pneumatic			
Electrical			
Instruments			
Structure	1	1	
Bleed Air			
Comm/Nav			
Prop/Rotor	1	1	1
Log Other			2
Log Total	**18**	**20**	**13**
Birdstrikes	1	1	2
Tests			
Weather			
Facilities			
Cargo Delivery			
Misc/Undetermined	2	2	
Misc/Undet/Total	**3**	**3**	**2**
USAF TOTAL	**62**	**63**	**19**

FIGURE 2.
1985 FLIGHT MISHAP FORECAST BY TYPE AIRCRAFT

Type Aircraft	Number Destroyed	Class A Mishaps	Class B Mishaps
A-7	3	3	1
A-10	5	5	1
A-37			
B-52	1	1	2
FB-111	1	1	
E-3			
E-4			
C-5		1	2
C-9			
KC-10			1
C-12		1	1
C-21			
T-39			
T-43			
C-130	2	2	1
C/KC-135			1
C-141	1	1	1
F/RF-4	13	13	1
F-5	3	3	
F-15	4	4	2
F-16	13	13	
F-106	1	1	
F-111	4	4	1
H-1	1	1	1
H-3	1	1	
H-53	1	1	1
H-60			
T-33	1	1	
T-37	1	1	
T-38	4	3	2
T-41			
O-2			
OV-10			
OTHER*	2	2	
TOTAL	**62**	**63**	**19**

*Gliders (TG-7, Z-26), Spooks, aircraft not listed, etc.

1985 MISHAP FORECAST

By Aircraft Type and Category of Mishap

AIRCRAFT		CONT LOSS	COLL GND	RNG	MID AIR	LDG (PLT)	T/O (PLT)	OPS OTH	FLT CONT	GEAR	FUEL SYS	ENG	ENG FOD	HYD/ PNEU	ELEC SYS	STR-UCT	BLD AIR	INST	LOG OTH	BIRD STRK	WX	UND MISC	TOT	FLYING HOURS
USAF	DEST	9	13	4	9	4		2	2		2	12				1			1	1		2	62	
	CL A	9	13	4	6	5	1	2	2	2	2	12				1			1	1		2	63	3,473,560
	CL B					3		1		2		7	1						3	2			19	
A-7	DEST		1	1								1											3	
	CL A		1	1								1											3	80,236
	CL B					1																	1	
A-10	DEST	1		2	1							1											5	
	CL A	1		2	1							1											5	222,071
	CL B									1													1	
A-37	DEST																						0	
	CL A																						0	31,363
	CL B																						0	
B-52	DEST		1																				1	
	CL A		1																				1	102,983
	CL B											1								1			2	
FB-111	DEST											1											1	
	CL A											1											1	20,633
	CL B																						0	
C-5	DEST																							
	CL A					1																	1	56,366
	CL B											1								1			2	
C-9	DEST																						0	
	CL A																						0	29,850
	CL B																						0	
KC-10A	DEST																						0	
	CL A																						0	22,243
	CL B																		1				1	
C-12	DEST																						0	
	CL A						1																1	30,123
	CL B																		1				1	
C-21	DEST																						0	
	CL A																						0	43,326
	CL B																						0	
C-130	DEST		1			1																	2	
	CL A		1			1																	2	378,713
	CL B											1											1	
C-135	DEST																						0	
	CL A																						0	263,798
	CL B											1											1	
C-141	DEST		1																				1	
	CL A		1																				1	290,009
	CL B									1													1	
E-3	DEST																						0	
	CL A																						0	31,284
	CL B																						0	
F-4	DEST	3	1		2	1		1			2	2										1	13	
	CL A	3	1		1	1		1		1	2	2										1	13	347,313
	CL B											1											1	
F-5	DEST	1	1		1																		3	
	CL A	1	1		1																		3	28,876
	CL B																						0	

1985 MISHAP FORECAST

By Aircraft Type and Category of Mishap

AIRCRAFT		CONT LOSS	COLL GND	RNG	MID AIR	LDG (PLT)	T/O (PLT)	OPS OTH	FLT CONT	GEAR	FUEL SYS	ENG	ENG FOD	HYD/ PNEU	ELEC SYS	STR- UCT	BLD AIR	INST	LOG OTH	BIRD STRK	WX	UND MISC	TOT	FLYING HOURS
F-15	DEST	1	1		1							1											4	
	CL A	1	1		1							1											4	186,673
	CL B												1						1				2	
F-16	DEST	1	4	1	2	1						4											13	
	CL A	1	4	1	1	1				1		4											13	220,845
	CL B																						0	
F-106	DEST											1											1	
	CL A											1											1	33,420
	CL B																						0	
F-111	DEST		1						1			1								1			4	
	CL A		1						1			1								1			4	81,246
	CL B											1											1	
H-1	DEST															1							1	
	CL A															1							1	47,310
	CL B					1																	1	
H-3	DEST		1																				1	
	CL A		1																				1	27,835
	CL B																						0	
H-53	DEST																		1				1	
	CL A																		1				1	14,459
	CL B							1															1	
H-60	DEST																						0	
	CL A																						0	4,266
	CL B																						0	
O-2	DEST																						0	
	CL A																						0	23,591
	CL B																						0	
OV-10	DEST																						0	
	CL A																						0	29,013
	CL B																						0	
T-33	DEST	1																					1	
	CL A	1																					1	52,916
	CL B																						0	
T-37	DEST	1																					1	
	CL A	1																					1	300,741
	CL B																						0	
T-38	DEST				2	1			1														4	
	CL A				1	1			1														3	358,468
	CL B					1						1											2	
T-39	DEST																						0	
	CL A																						0	17,861
	CL B																						0	
T-41	DEST																						0	
	CL A																						0	19,323
	CL B																						0	
T-43	DEST																						0	
	CL A																						0	17,300
	CL B																						0	
OTHER	DEST							1														1	2	
	CL A							1														1	2	
	CL B																						0	

A-7

LT COL DOUGLAS M. CARSON
Directorate of Aerospace Safety

■ The A-7 is an all-weather attack aircraft which entered the US Air Force inventory in 1968. Approximately 1,000 A-7 aircraft are still in service worldwide. The USAF has about 400 D and K models in service, mainly with the Air National Guard. Our USAF fleet flies about 80,000 hours per year and passed 1.2 million hours in 1984.

We have experienced 81 Class A mishaps with the A-7 from the first mishap in 1970 through the end of 1984, which has yielded a cumulative Class A mishap rate of 6.5. These 81 mishaps resulted in the destruction of 81 aircraft and the loss of 35 lives. The mishap rate compares favorably with other USAF fighter/attack aircraft with the A-7 having the fifth lowest destroyed rate of the 14 fighter/attack aircraft (Figure 1).

This mishap record is especially significant for two reasons. First, the A-7 is a single-engine aircraft. All other fighter/attack aircraft with lower rates are twin-engine aircraft. Secondly, the A-7 is a ground-attack aircraft and continually operates in the low level environment where a high number of mishaps historically occur.

Figure 2 shows Class A mishap rates and trend for all A-7 Class A mishaps since 1970 through the end of 1984. The solid line shows the varying annual mishap rates, and

continued

Figure 1

Fighter/Attack Destroyed Rates
Flight Mishaps Only
as of 31 DEC 84

RANKED BY LIFETIME DESTROYED RATES

Aircraft	Total Hrs	Destroyed	Rate
A-10	1,129,230	43	3.8
F-15	973,457	38	3.9
A-37	592,592	27	4.6
F-4*	8,586,655	454	5.3
A-7*	1,206,785	81	6.7
F-111	1,100,580	78	7.1
F-106	1,548,965	111	7.2
F-16	549,969	44	8.0
F-5	341,461	32	9.4
F-101	1,993,445	194	9.7
F-102	2,606,799	259	9.9
F-105	1,665,921	259	15.5
F-100	5,470,562	888	16.2
F-104	643,684	162	25.2

*USAF Only

Figure 2

A-7 continued

the straight dashed line projects the trend. The blocks at the bottom show the actual number of mishaps and rates for each year. To make this "big picture" more meaningful, let's break it down into operations-related and logistics-related mishaps, and then discuss last year's mishaps in more detail.

There have been a total of 47 operations-related mishaps through the end of 1984. Two categories accounted for over three-fourths of all ops-related mishaps. Loss of control was responsible for the loss of 18 aircraft and 12 lives. The other category involved collision with the ground — unfortunately, the fatality rate in this type of mishap is rather sobering — 18 aircraft were destroyed and 17 pilots were killed. Twelve of these mishaps occurred on air-to-ground ranges, and six were nonrange collisions with the ground. Five midair collisions claimed seven aircraft and two lives. Miscellaneous causes accounted for the five remaining aircraft losses. Figure 3 shows the operations-related mishaps and trend from 1970 through 1984.

Now, let's look at Class A mishaps which were attributed to logistics. Logistics-related mishaps accounted for 33 destroyed aircraft but only 4 fatalities.

The TF41 engine has been the single greatest problem we've had with the A-7. Eighteen aircraft were lost along with many other close calls. Early engine fixes started in the mid-Seventies are about 98-percent complete.

In recent years, most engine failures were due to second stage high pressure turbine (HPT-2) failures. The fix is a new design turbine wheel which is being retrofitted into engines in the form of HELP (High Pressure Turbine Extended Life Program) kits. The retrofit is approximately 15-percent complete, and at the current kit production rate, will be fully implemented by the summer of 1987.

In the interim, a livable (no pun intended) recommendation has been made to avoid the 94.5-97.5-percent rpm range to the greatest extent practical on unmodified engines (operation in this rpm range sets up a fatigue-inducing resonance in the high pressure turbine wheels and blades). Risk analysis indicates that at least one aircraft can be saved if operation in the 94.5-97.5-percent rpm range can be reduced by one-half.

However, even with this projected level of reduced operation, there is a probability of losing another A-7 before all TF41 engines have the new turbines. Data shows that risk is directly proportional to exposure, so it's the responsibility of each pilot to operate unmodified engines outside this range whenever possible.

Let's now look at 1984. During this year, the A-7 fleet experienced six Class A mishaps. All six aircraft were destroyed; four pilots were killed. Three were operations related and one was logistics related. The two remaining were still under investigation at the time of this writing, but the evidence indicates they were both operations related!

The first ops mishap involved an aircraft on a single ship surface attack mission at an uncontrolled range. Prior to initiating scheduled practice bomb runs, the mishap pilot made unauthorized low passes across the target area. On the mishap pass, the pilot had pulled up and rolled into a dive directly at one of the range towers. The aircraft passed over the top of the tower and impacted the ground beyond. The pilot made no attempt to eject and was fatally injured. The aircraft was destroyed.

In the second mishap, the mishap aircraft was a scheduled 1 v 2 DACT mission against two F-4E aircraft which reverted to a prebriefed alternate 1 v 1 DBFM mission when the lead F-4 ground aborted. Following an intercept, the flight set up for a perch attack with the mishap aircraft starting from an offensive position 7,000-9,000 feet aft at 7 o'clock slightly high. The F-4 crew last saw the mishap aircraft as it crossed their 6 o'clock 1,500-2,000 feet back, 20-30 degrees nose low, with 90-120 degrees of bank.

During the engagement, the flight descended through the minimum engagement altitude. The flight lead

Figure 3

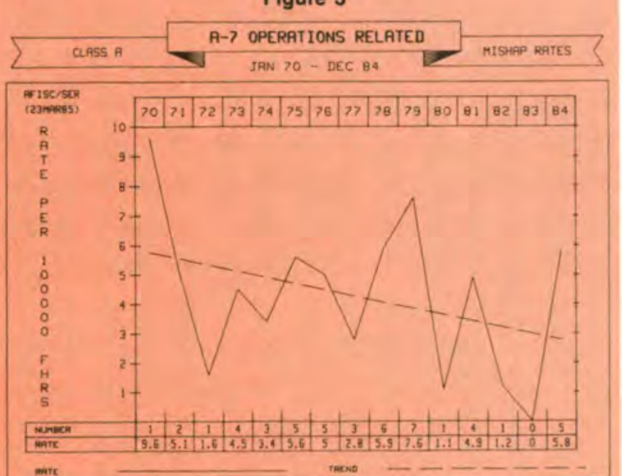
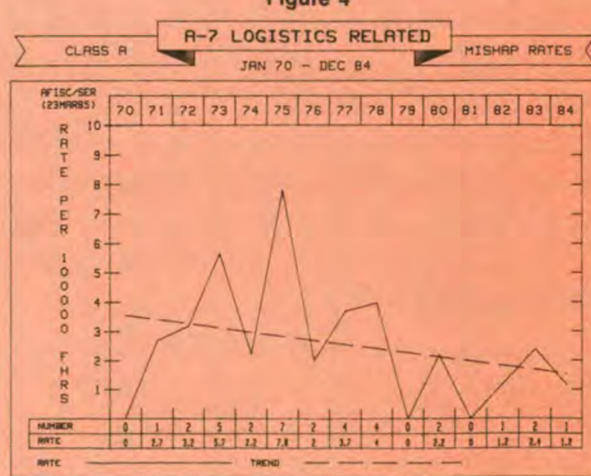


Figure 4



then terminated the engagement with a "knock it off" call which was not acknowledged by the mishap pilot. The F-4 crew started a left turn to re-establish visual contact with the A-7 and observed a fireball on the ground. The mishap pilot had attempted to eject, but was outside the envelope and was fatally injured. The aircraft was destroyed.

The third ops mishap was the first A-7K to be involved in a Class A mishap. The mishap aircraft was taking off from an en route refueling stop on a cross-country flight. Immediately after gear retraction, the aircraft settled back onto the runway about 3,000 feet from the departure end. The pilot initiated a timely ejection approximately 1,000 feet from the end of the runway. Neither pilot nor passenger were injured. The aircraft departed the runway, broke up, and exploded. The cause of the mishap was premature gear retraction.

One mishap was logistics related. The mishap aircraft was Number 2 in a two-ship flight on a night ground attack training range mission. Fifteen minutes after takeoff, passing FL 200, the mishap pilot felt vibrations followed by compressor stalls and high engine temperature. He declared an emergency, jettisoned his external tanks, and turned back to the airport. The pilot of the lead aircraft observed flames and sparks coming from the mishap aircraft. The mishap pilot then heard and felt an explosion followed by a complete loss of thrust. He stayed with the aircraft until reaching 2,000 feet and then ejected successfully. The aircraft was destroyed in the crash. The cause of the mishap was a catastrophic failure of the second stage high pressure turbine.

The two remaining mishaps are still under investigation. Both involved collision with the ground. The aircraft were destroyed, and both pilots were fatally injured.

There were also three Class B mishaps in 1984. All three were landing mishaps, and all involved operator error.

The first Class B mishap involved an aircraft on a cross-country flight. The pilot refiled in-flight for an ops stop to deliver unit accounting and finance documents. He dumped fuel to reduce gross weight, descended to VMC, and flew a visual approach. The aircraft touched down 500 feet down the wet runway at 140 KIAS.

The mishap pilot did not aerobrake, choosing instead to lower the nose to the runway and apply full antiskid braking. No braking was noted, and the aircraft began to drift left. He released the brakes, turned the antiskid off, and reapplied the brakes. Both brakes locked, resulting in reverted rubber hydroplaning and no braking action. The left main landing gear (MLG) tire blew out at 2,800 feet of runway remaining, and the left drift continued.

The pilot then engaged nose gear steering in an attempt to control the aircraft, but the left drift continued until the left MLG departed the asphalt surface onto the concrete shoulder which provided more traction. The aircraft then pivoted on the blown left tire and departed the left side of the runway approximately 110 degrees off the runway heading. The right MLG caught in the soft mud. The aircraft flipped over, came to rest about 5 feet from the concrete surface, and caught fire. The mishap pilot egressed unassisted through the broken canopy with minor injuries. The fire was quickly extinguished by firefighters.

In the second mishap, the mishap aircraft was scheduled as Number 3 in a three-ship flight for a combination surface attack tactics and parts pickup mission. The range portion of the mission was uneventful. While en route for the parts pickup at FL 310 on autopilot, the mishap pilot experienced a minor uncommanded yaw input which was self-correcting. The pilot then received clearance for an en route descent with vectors to an overhead pattern. A normal overhead pattern was flown, however, another yaw excursion occurred as the aircraft rolled out wings level on final. This resulted in a landing 2,500-3,000 feet long and at least 10 knots above normal landing speed. The pilot lowered the tailhook but missed two barriers, departed the overrun, and came to rest in a drainage ditch. The aircraft received substantial damage, but the mishap pilot egressed uninjured.

In the third Class B, the mishap aircraft was Number 2 in a four-ship flight on a ground attack mission. The flight was uneventful until the return to base. During the descent, the mishap pilot, who was checking out in the A-7, became preoccupied with other tasks and failed to move the flap handle from the "isolated utilities" position to the "flaps up" position as required by the descent checklist. While in the overhead traffic pattern, he was also distracted by low clouds at traffic pattern altitude and moved the flap handle from "isolated utilities" to "flaps up," believing he moved the handle from "flaps up" to "flaps down." He consequently flew a no-flap pattern and landed about 1,500 feet down the runway at 160 knots with the flaps up.

continued

A-7 continued

The mishap pilot then determined that he could not stop the aircraft in the runway remaining and lowered the tailhook to engage the departure end BAK-9. The aircraft engaged the barrier at approximately 110 knots, but the cable didn't stop the aircraft, and it departed the end of the overrun, sheared the landing gear on the concrete pad for the ILS antenna, and came to rest 50 feet past the overrun. The pilot shut down the engine and egressed without injury.

That's a brief rundown of the 1984 mishap experience for the USAF A-7 fleet. At the beginning of 1984, the Air Force Inspection and Safety Center predicted two Class A mishaps for the fleet in 1984. Unfortunately, we had six. Engine failure accounted for only one mishap as predicted. Operations-related mishaps accounted for the adverse trend this year. Sadly, all the ops-related mishaps were clearly preventable as they all involved breakdowns in flying discipline to varying degrees. Let's all learn something from 1984's tragic mistakes and apply them to the future.

Well, what about 1985? According to AFISC's computer prediction, there will be three A-7 Class A mishaps in 1985, two ops-related and one log-related, which will result in three destroyed aircraft. The ops mishaps will be collisions with terrain (fatal), and the log mishap will be engine related.

Remember, this is a prediction — not a goal! You must prove me wrong, especially about the fatalities. Fly smart — you'll fly safe. ■

A-10

MAJOR KENNETH M. SPURLOCK
Directorate of Aerospace Safety

■ The A-10A Thunderbolt II has just completed its 10th year of flying since the first production flight in March 1975, and is now flown by seven active wings, two test wings (Eglin and Edwards), five Air National Guard units, and four Air Force Reserve units. The last production aircraft, the 713th, was delivered by Fairchild Republic in March 1984.

The A-10 fleet has the best operational maintainability record in the USAF fighter/attack community. An example is the 23 TFW "Flying Tigers" who achieved an Air Force record of 91.5-percent mission capable and an 89.7-percent fully mission capable rate for fiscal year 1984. As of 31 December 1984, A-10 units had accumulated 1,127,700 hours of flying time with a cumulative Class A rate of 3.9, the best ever for an attack aircraft in USAF history.

The A-10 mishap record is a remarkable achievement considering the low altitude, high threat tactics flown by A-10 pilots daily. However, this rate translates into a loss of 43 aircraft and 22 pilots, or a loss of 2 squadrons of aircraft and a squadron of pilots. The figure gives a quick overview of all A-10 Class A mishaps.

Category	77	78	79	80	81	82	83	84	Cum.
A-10 CLASS A MISHAPS									
Operation Related									
Control Loss	1	1	1		1	2	1	2	9
Collision With Ground			2	2	1			1	6
Range	1	2	1		2		3	1	10
Midair Collision		1		1			2	1	5
Landing (Pilot)		1				1			2
Flameouts (Pilots)						1		1	2
Ops Other				1					1
Logistics Related									
Flameouts		1	1						2
Flight Controls			1		1				2
Engine Failure		1							1
Fire (Hydraulic)			1						1
Log Other							1		1
Undetermined									
			1	1					2
TOTAL	**2**	**7**	**8**	**5**	**5**	**4**	**7**	**6**	**44**

Comparing 1983 and 1984 mishap rates, 1984 was more successful with six Class As for a 2.7 rate compared with 3.1 in 1983. Five aircraft were destroyed resulting in three fatalities. The following are short summaries of 1984 mishaps:

- Popup to low angle bomb pass, impacted water, one fatal.
- During pulloff from a dry surface attack pass, impacted ground, one fatal.
- A-10 and Cessna midair, A-10 recovered, Cessna crashed and pilot fatal.
- En route cross-country, engine failed due to oil loss, impacted ground in GCA pattern, ejection successful.
- Aircraft departed controlled flight during a BFM engagement, unsuccessful ejection, one fatal.
- Engine loss, drive shaft failure due to oil fire, successful ejection.

One disturbing fact concerning 1984 Class A mishaps is that all of them had operator errors. Three of the mishaps were results of pilots rushing or not following established procedures, which is a very disturbing trend. On a positive note, only one of the mishaps involved loss of control in the air-to-air environment, which hopefully is a good trend after 1983.

Two Class B mishaps occurred in 1984. A birdstrike and an uncommanded gear collapse attributed to an unknown electrical input, accounted for these two mishaps.

Class C mishaps remained at 1983 levels but with reductions in the number of physiological, flight control, and gun-gas caused flameout mishaps. On the rise were engine-related mishaps.

There is light at the end of the tunnel with the engines. There are two ongoing TCTOs to replace the transition liners and the high pressure turbine blades. The Hot Section Life Improvement (HSLI) Program will get started in late 1985 or early in 1986. The HSLI Program replaces the major parts of the engine hot section. The Turbine Engine Monitoring System (TEMS) has proven to be very effective in a test program at Barksdale. Installation of this system will begin in 1985. It will detect engine problems well before a complete failure occurs in the air. These mods are certain to improve our engine reliability and should start decreasing the number of engine-related mishaps. An unhappy note is that all engines will not be modified until approximately 1990.

The fire detect system is being improved by rerouting the cable and adding sturdier support brackets to eliminate chafing. A totally new system is not cost-effective, so it will not be acquired.

The Batelle gun gas diverter has been contracted and is being installed in the aircraft. This will increase the interval between water wash cycles and their associated problems. However, the main benefit of this device, coupled with the engine-start modification during gun firing, is that it will virtually eliminate problems with gun gas flameouts.

Fuel foam fires are still with us. Red foam has replaced blue foam in the vent tank, but Alaska reported three fuel foam fires in December. This problem continues to receive high priority from the Air Force Inspection and Safety Center (AFISC), Sacramento Air Logistics Center, and the Aeronautical Systems Division. A specially instrumented A-10 was flown in Alaska in December of 1984 to gather data on electrostatic buildup levels in the A-10 in order to find the cause of the problem.

No article would be complete without a discussion of G-induced loss of consciousness (GLC). Thirteen A-10 pilots in their response to the AFISC GLC Survey affirmed that they had experienced G loss of consciousness while flying the A-10. Two A-10 mishaps in 1984 have suspected GLC involvement. Although the old Warthog can't pull hard that long, we are still susceptible to GLC. Get in shape, know your limits, test your equipment, and practice using proper anti-G straining maneuvers.

The forecast for 1985 reflects a 20-percent reduction in Class A mishaps, from 6 in 1984 to 5 in 1985. Increased awareness of A-10 flight characteristics, low level dangers, G-induced loss of consciousness, and single engine procedures should help reduce pilot factor mishaps.

This discussion has only skimmed the surface of some of the problems in 1984. If you want or need more details, give us a call at AUTOVON 876-3886 or write AFISC/SEFF, Norton AFB, CA 92409-7001. ■

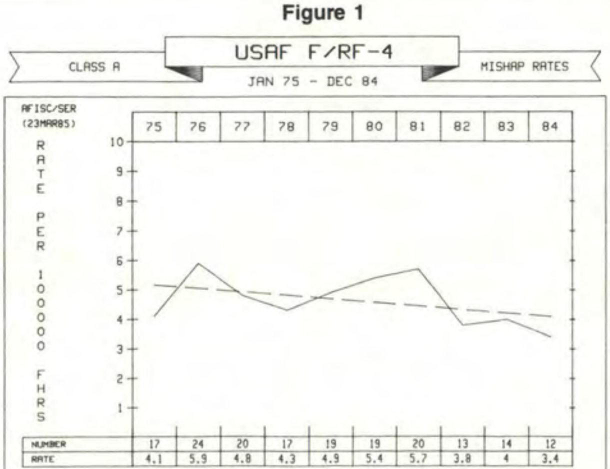
F/RF-4

MAJOR GARY R. MORPHEW
Directorate of Aerospace Safety

■ The F/RF-4 continues as the mainstay of the fighter world. An all-weather, multimission, multiple series aircraft, the F-4 moves into its third decade of reliable service. Still numbering over 1,600 in the Air Force inventory, the F/RF-4 is in a process of transition. As the newer weapon systems enter the active inventory, the F-4s are found in ever-increasing numbers in the Air National Guard and the Air Force Reserve. At the end of 1984, the ANG and AFRES held over 51 percent of the fleet.

While the system is starting to feel the fiscal pinch in favor of the newer systems, the prospects of the F-4G and RF-4C continuing service beyond the year 2000 are nearly certain. Having accumulated over 8.5 million flying hours since its arrival in 1964, the F-4 boasts the third lowest mishap rate among the existing fighting aircraft — 5.3 Class A mishaps per 100,000 hours. The two aircraft ahead of the F-4 are much newer and also have flown much fewer hours. In 1984 alone, the Air Force F/RF-4 fleet logged over 350,000 hours — over 40 percent of the fighter aircraft total and about 10 percent of the entire Air Force total.

Figure 1



So, how did 1984 compare with the past? Last year I challenged the F-4 world to a repeat performance and to better the forecaster's predictions. It is a pleasure to congratulate the operators, maintainers, supervisors, and support personnel on meeting that challenge. For the third year in a row, the total losses have been below that predicted. In 1984, 13 Class A mishaps were predicted. At year's end, we had sustained 12 Class A rate-producing mishaps destroying 11 aircraft. This accomplishment was achieved despite having over 15,000 additional flying hours above 1983's requirements. With all that said, the 1984 statistics give the F/RF-4 an annual rate of on-

Figure 2
Logistics Factor Mishaps

	1982	1983	1984
Engine	2	1	1
Fuel System	2	1	2
Flight Controls	1	0	0
Bleed Air	1	0	0
Electrical	0	1	0
Landing Gear	0	0	1
Misc/Undetermined	0	0	1
	6	3	5

Figure 3
Operations Factor Mishaps

	1982	1983	1984
Loss of Control	2	4	3
Collision W/Ground (Nonrange)	4	1	1
Collision W/Ground (Range)	1	0	0
Midair Collision	0	2	2
Fuel Starvation	0	1	0
Landing	0	0	1
	7	8	7

ly 3.4 — its lowest overall rate ever! (See Figure 1.)

Breaking down the mishaps, however, we shed more light on this success story and find everything is not as bright as we might expect.

In the logistics area, 1984 was another very good year. Despite the heavy task of trying to meet 1983's logistics rate of 0.89 with 3 mishaps, the maintainers managed to meet the prediction of 5 Class As (Figure 2). This still is a great achievement knowing the extent of the flying time, the age of the weapon system, and the five very different models. This resulted in a logistics-related rate of 1.4 for 1984.

1984's log mishaps included a centerline tank fire, an afterburner liner separation and fire, a wheel failure during landing, an internal wing fuel transfer failure, and an undetermined double engine failure — likely attributed to a turbine wheel separation. Of note in these mishaps, however, is that 3 of the 5 mishaps were directly linked to the unit's maintenance practice and another to the technical order guidance for unit maintenance. Aside from the unknown engine malfunction leading to the double engine failure, no major aircraft system independently failed and resulted in a lost aircraft. The 4 log mishaps for which a cause is known may have been preventable if we had only followed the TOs or made them more accurate.

We find operations-related mishaps are driving the mishap rate up. In Air Force statistics as a whole, the operations rate exceeded the predictions. In 1984, the F/RF-4 world was predicted to sustain 7 ops mishaps; we had 7 (Figure 3). This gave us an overall operations rate of 2.0. In past years, we might have believed this was a very good year, and, to be sure, we have seen much worse. The real story is while the log rate has been steadily declining, the ops rate has leveled off! There must be a way to improve!

Operations mishaps for 1984 include:

- Three mishaps involving loss of control. While loss of control in the F-4 seems to be a way of life, we can reduce this area by flying smarter. The aircraft hasn't changed the way it flies, we just get complacent and allow the fangs to get the better of our judgment. All 3 loss-of-control mishaps involved BFM/ACT maneuvers requiring *rudder* to roll while maintaining high AOA. I know what you slat drivers are thinking now, but the observation still stands.
- One mishap resulted in collision with the ground during a night low level. This mishap also accounted for 2 of our 3 fatalities in 1984.
- Two mishaps were the result of midair collisions. One midair occurred during a lost wingman procedure, and the other occurred during DACT, resulting in our only other fatality. Each of these mishaps involved a breech of rules — discipline!
- One mishap was the result of a poor landing. It involved a formation landing with the wingman landing partially off the runway. Here, of course, a better leader-runway cross-check before the landing would have eliminated the need for the investigation board.

The F/FR-4 fleet experienced one Class B mishap in 1984. Loss of a left engine nozzle seal allowed the afterburner plume to rapidly burn through the left overheat loop (rendering it inoperative) and then the keel section, until it illuminated the right overheat light. The crew unknowingly shut down the good engine! This mishap, and a few similar ones over the past year and a half, have given the engineers a

continued

F/RF-4 continued

problem to fix in the fire/overheat warning system. It no longer is an isolated incident!

The Class C and HAP reports throughout 1984 have demonstrated continuing problems such as engine compressor stall/flameouts at high AOA, FOD, and canopy malfunctions. Many reports are trying to warn us about the Class As and Bs in the future, and we need to pay attention to the investigators and seriously evaluate their recommendations. We, at the action levels, should demand full, accurate, and properly formatted reports so that when we analyze these "minor" mishaps ($99,999.99 is a "minor" mishap?), we can prove the need for a fix if one exists.

Modifications on the F/RF-4 are continuing to improve the reliability and safety of the system. New modifications, which will probably be seen throughout the fleet in the upcoming year include the high performance centerline tank, the voice warning system, and the outer wing reskinning.

Areas of special interest currently being evaluated or reevaluated are, for example:

▪ **Afterburner Fuel Pumps** While the tremendous modification effort to reduce the shear sections on all AB fuel pumps was successful in preventing catastrophic engine bay fires, the bearings continue to fail. Sometimes the pumps leak after the failure. Thus far, we have been fortunate we kept the amended procedures and monitored all AB malfunctions. Recently, we asked the item managers to reevaluate the bearing problem in the hopes of improving the reliability before we suffer another fire.

▪ **One Piece Windscreen** This has been a year of ups and downs for this modification. Without going in great detail, suffice it to say the modification is alive. The new windscreen passed the 500 knot/four pound bird test, and we hope to see it as a viable modification in the very near future. The MAJCOMs have indicated support for this safety mod, so it may be a reality yet!

▪ **Fire/Overheat Warning System** The new pneumatic system (TCTO 1235,6,7) modification has nearly been completed. All aircraft should be modified in 1985. The problems mentioned in the Class B mishap have shed new light on the use and meaning of the warnings. Pending further engineering fixes, just keep checking the system whenever your curiosity is aroused. Look for confirmation and follow procedures! Oh, yes, if you are the wingee and are asked to look for damage, look closely at both sides, top and bottom, before you report "nothing seen."

Another area needs a few comments after last year's experience. Since 1 December 1983, we have had 4 Class A mishaps which involved a departure from the runway. While the causes of the departure varied widely, some ideas need to be shared. Don't plan on a drag chute (2 had failures), or a cable arrestment (3 missed engagements), or a hard infield (all 4 had soft surfaces). Make your plans before you step, and keep the other crewmember (and flight members) advised of your intentions. If a runway departure seems imminent, do things together as a crew. If ejection is your personal answer to the question as it arises, pull your own handle! Two of the 4 mishaps involved a disabling of the sequenced ejection system.

Finally, for all you statisticians in the audience, the F-4 fleet experienced one other Class A mishap this year that was not mentioned above. This is because it involved a Research and Development mission and similarly coded aircraft. This aircraft was conducting a weapons test when the pilot perceived the lack of control response. An ejection was successfully accomplished at low altitude. This R&D mishap is not rate producing.

I again challenge the F/RF-4 world to better the predictions for 1985. The predictors have said to expect 12: 6 operations, 5 logistics, and 1 miscellaneous Class A mishaps. Let's get the logistics rate back down, and, operators, show me that a downward trend can be started in 1985 with a quantum decrease. Fly smart, look out for each other, and don't overlook the small problems that can grow into a TDY for an investigation team. ■

F-5

MAJOR BOB MULVIHILL, CF
Directorate of Aerospace Safety

■ The USAF operates approximately 100 F-5 aircraft, 2 less now than at the beginning of 1984. PACAF, USAFE, and TAC use F-5s mainly as aggressor aircraft. TAC also uses them to train aggressors and foreign pilots. TAC is the prime operator with approximately 70 percent of the fleet.

USAF F-5 pilots flew about 29,000 hours in 1984 and had a Class A mishap rate of 6.9 per 100,000 hours. The bad news is that this was twice the overall TAF rate! The good news is that the 1984 rate compares quite favorably with the 1983 rate of 10.1 and the F-5 lifetime rate of 9.4. However, before we start patting ourselves on the back, we should note the most important statistic of all; one of the two 1984 mishaps resulted in the loss of a pilot. Here are brief descriptions of 1984 mishaps.

■ The mission was a 2V2 with two F-5Fs versus two F-16s. During a defensive pullup to force a vertical overshoot, the mishap aircraft departed controlled flight at about 23,000 feet and rapidly entered a flat spin. Although the pilot applied spin recovery controls for 55 seconds, the aircraft did not recover. The pilot wisely ejected at minimum ejection altitude.

Lessons Learned

■ Contrary to popular belief, the F-5 does have some unforgiving flight characteristics. Once it departs, it can quickly progress from an upright spin to a flat spin from which recovery is unlikely. At present, there are no artificial stall warning devices or control limiters. It's up to the pilot to keep his aircraft from departing. A departure warning system is under development. It will use a microcomputer to analyze flight parameters and provide an audio and/or visual warning of impending departure. A prototype is due to be test flown in November 1985, so fleet retrofit is still a long way off. In the meantime, F-5 pilots will have to fly smart and avoid crossing the thin line between controlled flight and a nylon letdown.

■ USAF two-seat F-5Fs (like the Es) were produced with leading edge extensions (LEX) and a shark nose to improve directional stability. However, because of the extra length and the lift available from the LEX and shark nose, the F model is less stable in pitch between stall and 44-degrees AOA. When compared to the E model, the F model can

continued

generate extremely high pitch rates, making it possible to progress from low AOA to well above stall in as little as two seconds, with no stall warning cues. This can be done with less than abrupt and/or full aft stick movement. In short, you can't manhandle the F model in pitch the same way you can the E model.

The second mishap occurred during a two-ship BFM continuation sortie. On the fourth engagement, the mishap pilot entered a hard right descending turn. After entering the turn, the pilot made no radio transmissions nor did he make any attempt to eject. G-induced loss of consciousness (GLC) was determined to be the most probable cause.

Lessons Learned

■ The F-5E/F is quite capable of producing the rapid onset rates which will produce GLC. The present anti-G suit is unable to react to rapid onset rates, and a high-flow-ready-pressure valve is under development. It is not scheduled to be incorporated in the F-5 until at least late 1986, but even with a new anti-G suit valve, it will be quite possible to experience GLC in an F-5. *The most effective way to increase G tolerance is an effective/efficient M1/L1 maneuver.*

■ During an ACBT mission, G tolerance generally decreases with each successive engagement. Pilots would be well advised to pull in their fangs and use their superior skill and cunning rather than their physical prowess to defeat their opponents, especially after a few engagements.

Operations-related mishaps continue to dominate. Both 1984 mishaps are classified as operational, bringing the lifetime F-5 Ops total to 21 of 32 Class As. Sixteen of those 21 have involved collision with the ground or pilot loss of control. Only you, the operator, can prevent this type of mishap.

There were no Class B mishaps, but there were 73 Class C mishaps in 1984. What is alarming is that 65 percent of all Class Cs were engine flameouts. Many of the flameouts were preventable. The most common causes were throttles, throttle stops, MFCs, or IGVs slightly out of rig.

The J85 is a very sensitive engine and requires special care and attention. If these flameouts continue, it's only a matter of time before we lose an aircraft to a double engine failure. Maintainers should be exhausting every possibility to improve the quality of work and quality assurance in their engine shops. All is not gloomy, however. The trend line for flameouts over the past year has shown a decline. If you can continue to accelerate this downward trend, perhaps next year we can report that the problem no longer exists.

The F-5 mishap rate has seen some improvement in 1984, and that is a step in the right direction. Let's resolve to keep that momentum going in 1985. The best way to achieve this is to cut down on operational mishaps. Because of the limited number of F-5 hours flown each year, the loss of just one aircraft greatly affects the mishap rate and reflects poorly on all F-5 pilots.

On the other hand, if the F-5 community can achieve a reduction of two Class As in 1985, we will have brought about a 100-percent reduction in our Class A rate. Most importantly, no F-5 pilot will have lost his life. ■

F-15

MAJOR MICHAEL J. KAYE
Directorate of Aerospace Safety

■ The USAF possesses 690 F-15 aircraft which include 319 A, 52 B, 279 C, and 40 D models. The contracted buy in 1985 is 38 aircraft. F-15s destroyed in flight and ground mishaps since the aircraft became operational in 1974 include 26 A, 5 B, and 10 C models. From 1974 through 1978, logistics accounted for 11 out of 15 Class A flight mishaps. From the beginning of 1979 through 1984, operations accounted for 17 out of 25 Class A flight mishaps, with pilot-induced loss of control the major problem.

From a safety standpoint, 1984 was an outstanding year for the Eagle. Five Class A mishaps were forecast for this period, but only three occurred — two involved loss of control and one suspected spatial disorientation.

Both of the loss-of-control mishaps were operations related. One occurred when the mishap pilot input aft stick in an attempt to decrease a nose-low attitude while the aircraft was in a departed condition. This stabilator deflection increased the aircraft angle of attack, and with yaw rate and sideslip present, the aircraft entered a left spin. The pilot ejected successfully.

The second mishap developed when the pilot stalled the aircraft in a nose high attitude above an undercast. During recovery, the aircraft tucked to an inverted attitude. The pilot became spatially disoriented and ejected successfully shortly after entering the undercast.

The third F-15 Class A mishap remains undetermined, although it appears a combination of task saturation and spatial disorientation/misorientation were principal factors. The mishap pilot was attempting to maintain VFR in marginal weather, interpret radar information, and resolve a navigational error when the aircraft entered a steep descending turn from which it did not recover. There was no evidence of an ejection attempt by the pilot or his passenger.

The reduction of F-15 Class B mis-

continued

haps in 1984 is also noteworthy. Only two incidents occurred, both involving engine anomalies/fires. The first incident occurred when seven fourth stage turbine blades failed resulting in a fire and explosion, causing serious impact and fire damage to the right engine and engine bay. The second mishap occurred when an engine diffuser case failed, causing extensive fire damage to the aircraft and engine.

The following were primary F-15 safety concerns in 1984.

Augmentor Burnthrough Since the beginning of 1980, the F-15 fleet has experienced 3 Class B mishaps and over 45 Class C or HAP incidents due to augmentor burnthrough. These burnthroughs are primarily due to misinstallation and fractures of components in the augmentor nozzle section. The failure of any one of these components disrupts cooling airflow and allows the augmentor flame to penetrate the augmentor nozzle section of the aircraft. Since these fires are aft of the fire detection circuitry, they do not activate the firelight. Engine instruments also indicate normal operation. The problem is normally identified by a wingman who observes flames trailing from the aircraft. Deselection of afterburner will result in decreased fuel flow and extinguish the fire, although it may take in excess of 30 seconds for it to actually go out.

As an immediate action interim fix, F-15 TCTO 899 was issued directing inspection of proper installation and correct materials in the critical area. Additionally, four major improvements are underway to correct this problem. These include an improved durability augmentor liner, newly designed nozzle attachment hardware, a nozzle balance flap rigid connecting link (dogbone link) constructed from more fatigue resistant material, and hinge pins designed to eliminate installation errors. All of these improvements have been included in production engines as of August 1984. Fleet retrofit is expected to begin this summer and involves an accelerated augmentor improvement effort similar to the F-16 Falcon 100 Program.

Landing Gear Malfunctions Landing gear system malfunctions continued to be an area of primary concern. Modification of the landing gear circuit to eliminate false indications and landing gear failure to extend is being accomplished by ECP 1460 and TCTO 1F-15-791. These actions began in May 1983 and should be completed by April 1986. Additionally, efforts by the F-15 Landing Gear System Review Team formed in January 1984 represent a further successful attempt to reduce the landing gear incident rate.

Stabilator Actuator Input Arms Input arms have failed on four occasions, and one of these failures resulted in the loss of an aircraft in 1983. A permanent fix was developed in 1984 which eliminates the problem. TCTO 871 involves a new antirotational lug/clevis and summing lever weight removal. Retrofit began in November 1983 and was completed in mid-1984. The remaining fixes, which involve an input arm made from Inconel 718 and a self-centering mechanism, are included in ECP 1757. Production hardware deliveries are scheduled for August 1985, and complete retrofit is predicted by mid-1986.

Pilot-Induced Loss of Control Loss of control is the leading cause for F-15 operations-related Class A mishaps and accounted for two out of three Class A mishaps in 1984. Both incidents involved a lack of understanding of F-15 flight characteristics and failure to follow flight manual procedures. Pilot awareness programs were begun in April 1984 and involved *Flying Safety* magazine articles addressing F-15 handling characteristics, contractor briefing on departures/spins, and expanded flight manual discussions.

The F-15 Class A mishap rate of 1.7 was the lowest recorded since 1976 and represents a significant achievement in which we can take great pride. This rate is significantly lower than the overall 1984 fighter/attack rate of 3.6 and helped establish the F-15 as the safest USAF fighter in history at the one million-hour mark. Efforts throughout the year have paid off and demonstrated that the F-15 community can continue to improve on an already enviable record. Let's keep up the excellent work in 1985. ■

F-16

F-16 SAFETY TASK FORCE
Directorate of Aerospace Safety

■ It is always gratifying when superior efforts are rewarded by superior results. Such is the case for the F-16 in 1984. In spite of a significant increase in flying hours over 1983, the number of F-16 mishaps actually decreased from that experienced in 1983. The net result was 10 Class A mishaps, with a rate for 1984 of 5.0, the lowest ever for the F-16 (see figure).

The most significant gain in lowering the rate was a reduction in logistic causes. In 1984, only three mishaps listed logistics as a primary cause, all of them for engine malfunctions. In contrast, a total of seven mishaps listed operations factors as a primary cause. The following is a breakdown of the 1984 Class A mishaps.

- Ten actual (18 forecast).
- Seven operations factor.
- Two G-induced loss of consciousness.
- Three spatial disorientation.
- One collision with the ground (range).
- One hard landing.
- Three logistic factor — engine.

While looking at these numbers and realizing that we have done well overall, it is imperative that we keep sight of the most important factor in mishaps: The loss of our friends and fellow pilots. In 1984, six of the seven operations-factor accidents resulted in pilot fatalities.

In 1984, we continued an adverse Ops trend that started in 1983 with operations-factor mishaps first equaling and now outnumbering the logistic-factor mishaps (Table 1). As you can see, the shift has become significant and indicates the need for considerable effort in the operations factor area if we are to improve our record in 1985. At this

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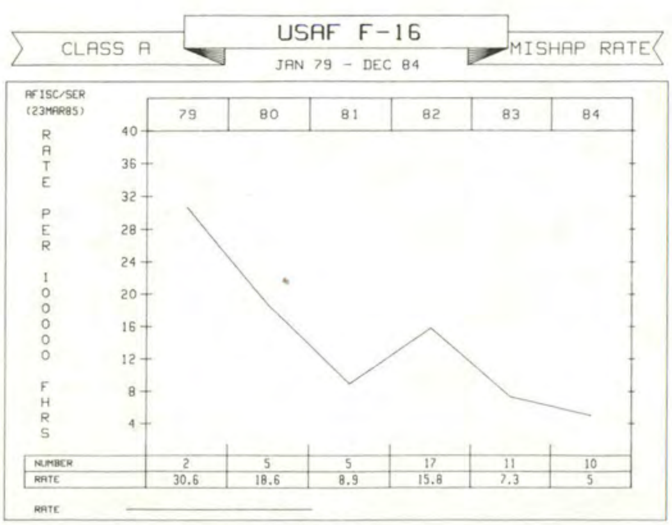

Table 1
Operations vs Logistics Mishaps

	OPERATIONS	LOGISTICS
1979 - 1982	12	17
1983	5	5
1984	7	3

Table 2
Total vs Operations Mishaps

	TOTAL	OPERATIONS
1979 - 1982	31	12
1983	11	5
1984	10	7

Table 3
Operations Mishaps by Cause Factor

	1979-1982	1983	1984
Pilot Induced Control Loss	3	0	0
Collision With Ground	2	5	4
(G Loss of Consciousness)	(0)	(2)	(2)
(Spatial Disorientation)	(1)	(2)	(2)
Collision With Ground - Range	2	0	2
(G Loss of Consciousness)	(0)	(0)	(0)
(Spatial Disorientation)	(2)	(0)	(1)
Midair	1	0	0
T.O./Landing	2	0	1
Pilot Induced Flameout	2	0	0
TOTALS	12	5	7

F-16 continued

point, it may be valuable to look at our 1984 mishaps, focus on their primary cause factors, and outline the steps being taken to solve the problems.

Logistic Factor Mishaps

We will start by covering the logistic-factor mishaps. The breakout of the malfunctions shows:

- A fuel manifold bracket failure leading to flameout from fuel starvation (caused by vibration from a first stage blade failure).
- Augmentor nozzle burn-through.
- Fan compressor knife-edge seal failure.

Two factors are significant when reviewing these three malfunctions. First, all three problems had previously been identified, and corrective action was underway to modify the engines. Second, even though design deficiencies had been identified, it was also possible that human error could have been responsible in any one of the mishaps. The conclusion here is that even after fixes have been incorporated, technical order procedures must be followed precisely to prevent human errors from resulting in logistic factor mishaps.

Two key engine modification programs are currently underway to correct deficiencies:

- Replacement of the knife-edge compressor seals with a flat edge seal in order to improve strength.
- The Falcon 100 Field Level Retrofit Program (13 engine TCTO's including the fuel manifold bracket, the augmentor nozzle improvements, and RCVV modifications).

Efforts to accelerate these programs have been hampered by the availability of parts, personnel, and engines, which has directed the current retrofit/modification schedule.

Other upgrade programs underway in the logistic area are:

- Falcon Rally II: A depot level program which modifies the electrical system to provide true dual redundancy for the flight controls through the Quad PMG.
- Falcon Rally III: Improvements to the main generator and several antichafing modifications.
- Falcon Rally IV: EPU speed sensors and audio FTIT warning for stagnations.
- Falcon Sweep: LEF asymmetry brakes, takeoff and landing gains modification (power approach), and FLCC modification to control pitch-up on landing roll.

One last discussion about the engine before going on. Although not much can be done by the pilot in the event of catastrophic engine failure, there are engine problems which can be successfully handled by the pilot. In single engine aircraft, it is vital that the pilot understand engine operation, including backup options, and that he have a plan ready when things go wrong. It appears that some earlier reluctance to turn the EEC off, or even to go into BUC if the problems per-

sist, has pretty much gone away. We have gotten BUC starts and operated successfully in BUC on several occasions. Hopefully, this has built up our confidence in the system.

However, there are a couple of potential problems. The first is returning to land with an engine operating successfully in BUC and then flying an overhead SFO pattern. This has resulted in long, hot landings which have the potential for running off the runway. Flight manual changes have been made to recommend flying a straight-in approach in these situations to preclude flying a pattern designed for no-thrust when we actually have more than normal thrust available at idle.

The second problem is continuing airstart attempts below minimum safe ejection altitude. Although unquestionably easier to say than to do, we must maintain situational awareness at all times in emergency situations. A key number to track during airstart attempts is altitude. Keeping in mind that there are failure modes where the engine will *never* relight through either the UFC or the BUC, we must discipline ourselves to know when to eject, rather than to hang in for one more try.

Operations Factor Mishaps

Clearly, the most significant portion of our mishap record for 1984 was in the area of operations. Table 2 shows that, in spite of our constantly improving overall F-16 mishap record, our numbers of operations-factor mishaps remain high and actually went up from 1983. Table 3 shows the distribution of operations-factor mishaps based on the primary cause factors, using a slightly different format from past versions to highlight G-induced loss of consciousness (GLC) and spatial disorientation (SDO).

With the exception of the hard landing and the range mishap where a popup was continued in spite of a late pullup well inside the MAP, all of the other F-16 operations factor mishaps in 1984 involved either GLC or SDO. While acknowledging that other factors were also involved in each of these mishaps, the bottom line shows GLC and SDO as critical 1984 mishap causes.

GLC has been an issue now for several years. Modifications have been made to G-suit connectors, and several articles and a survey have been published to identify, study, and educate us all on the problem. Research has shown that the most significant factor involved in overcoming GLC is a properly done M-1/L-1 maneuver. Initial studies indicate that quite a few of us are doing these maneuvers improperly. Although our improper procedures are protecting us in most situations, they have let us down with high onset rates or sustained high Gs.

Several centrifuge programs are currently underway to provide training on proper M-1/L-1 maneuvers. Additionally, a high flow G-suit valve has been tested which will provide faster and more effective G-suit response. Further studies are being made in this area to gain a better understanding of the problem and to provide solutions for existing and future aircraft.

Spatial disorientation has, of course, been a factor ever since men started flying in adverse conditions such as night or weather. Unfortunately, knowledge that a phenomenon exists and training in how to combat and overcome the problem does not always ensure success in critical situations. One of the givens in a single-seat aircraft is that there is only one person who can ensure

continued

F-16 continued

that the aircraft is properly flown. Distractions, task saturation, and channelized attention all have the effect of slowing down or even stopping the instrument cross-check at critical junctures in a mission. When allowed to continue too long, they can lead the pilot to fly the aircraft to a position from which he cannot recover.

In spite of the widely disparate circumstances involved in the F-16 operations-factor mishaps, one factor was present in most of them — fatigue. Although difficult to pinpoint on an individual basis, chronic fatigue is a by-product of the long duty days over extended periods of time. Furthermore, a switch to a night flying schedule or to an exercise can make the situation even worse.

Fatigue leads to errors in judgment and creates an environment conducive to task saturation and channelized attention. Fatigue has also been shown to be a factor in reducing G tolerance as well. When combined with a layoff from high G flying for even a few days, the results can be disastrous. The environment we work in has proven to be exceptionally unforgiving, with little or no room for error. The presence of fatigue and its effect on performance must always be taken into account. As that famous fighter pilot Dirty Harry once said, "A man has got to know his limitations."

Outlook For 1985

Looking ahead in 1985, there may be some benefit in attempting to anticipate what our problems might be. There is no certainty to the items pointed out here, and no guarantee we won't uncover an unknown failure mode. These are, however, areas that can have an impact on mishaps. Careful study and preplanning can result in a successful recovery of the aircraft.

Logistic Factors

- Engine: The engine has been the most significant cause of logistics mishaps in the F-16. Current modification programs should be completed this year. Pilot actions are critical and must be preplanned.
- Leading edge flap system.
- Landing gear, brakes, and tailhook. As long as the gear must be pinned prior to engine shutdown, the potential for personnel ingestion remains.
- Electrical system, including wire bundle chaffing.
- F-16C/D peculiar systems introduce opportunities for discovering new failure modes.

Operations Factors

- Judgment: Supervision as well as flying.
- Mission preparation: Suitability of the mission based on pilot capabilities as well as thorough mission planning.
- Human factors: Fatigue, task saturation, channelized attention, overcommitment, pressing, spatial disorientation, and G-induced loss of consciousness.
- Landing: Transitioning from IMC to VMC, misinterpretation of available cues, and jetwash behind an aircraft.
- Flight discipline: Establishing a game plan within the prescribed directive, briefing it thoroughly, and then properly executing it.

Summary

There is every reason to expect that 1985 will be a better year than 1984. Our modification programs will continue to upgrade aircraft and engines to reduce past logistics problems. Mature judgment and proper planning have the potential to significantly reduce our operations-factor mishaps. Each one of us has a personal stake in reducing the number of mishaps and a direct responsibility for accomplishing the goal of improving on the record we set in 1984. ■

F-106

MAJOR BOB MULVIHILL, CF
Directorate of Aerospace Safety

■ The F-106 has been a frontline interceptor through three decades. As it reaches the twilight of its life, it has become a safe and reliable aircraft to fly. Last year, we urged you to be careful so we could break the record of 23 months without a Class A mishap. We didn't make it, but the pilots really came through for us. In 1984, there were no F-106 mishaps attributed to operations factors. In fact, in the one logistic-related Class A mishap, the pilot handled the emergency in a truly professional manner.

The mishap occurred during a routine two-ship flight lead upgrade mission. During a rejoin, the pilot noticed the loss of his radar power and a master caution light. Noting a deceleration, he checked his engine instruments and confirmed that he had a flameout. He declared an emergency and, within 15 seconds, had correctly diagnosed an accessory drive failure. He deployed the RAT to maintain aircraft control, attempted two airstarts and, when they were unsuccessful, made the decision to eject. He turned his aircraft toward an unpopulated area and ejected at 7,000 feet MSL, nose-up, with 180 knots. He was uninjured except for a bruised elbow which he received on ground impact.

Lessons Learned

■ A thorough knowledge of your aircraft systems is invaluable. Because the pilot understood his systems, he was able to rapidly diagnose the mode of failure and made a timely decision to eject. Had the flameout occurred at a lower altitude, this pilot possessed the knowledge to permit time for a successful ejection. How about you?

■ The tower shaft on this engine had been removed and replaced during engine maintenance in January 1983. Maintenance records from that time were incomplete and did not specify the source of the shaft. In fact, investigation revealed that a bent or defective tower shaft could have been installed at that time. We'll never know. Maintenance personnel must be specific when they fill out the AFTO Form 95, "Significant Historical Data."

■ The pilot's seat pack did not deploy properly. This happened because the pilot did not let go of one of the seat handles. As a result, he and the seat pack were rotating when they separated from the seat. This jammed the seat pack, and the pilot had to release it manually. When the seat pack fell away and was lost, it denied the use of voice on Guard during the rescue effort because the seat pack ELT beacon was continuously transmitting on Guard. The lesson: *Let go* of the handles once you've used them for the purpose they were designed. In fact, back home in the Great White North they teach us to let go and place our hands and wrists between our legs to protect our . . . er . . . elbows.

There were no Class B mishaps in 1984, and engines accounted for 9 of the 31 Class Cs. Two FOD mishaps caused reportable damage last year.

One of the goals at the Air Force Inspection and Safety Center is to effect a 20-percent reduction of Class As in 1985. F-106 pilots showed us the way in 1984. I challenge both the operational and the logistics side of the house to achieve a zero Class A rate in 1985. Until the 1984 mishap, we had gone 16 months without a mishap; however, the record of 23 months still stands. Let's not only beat it, but keep the momentum going. Who knows, it just might catch on in the rest of the United States Air Force. ■

F/FB/EF-111

MAJOR MICHAEL J. KAYE
Directorate of Aerospace Safety

■ General Dynamics, Fort Worth Division, delivered the first F-111 to the Air Force in 1966, and a total of 531 aircraft had been delivered when the contract terminated. The USAF F/FB/EF-111s are flown operationally by TAC, SAC, and USAFE, and have accumulated approximately 1.5 million flying hours. Their primary role is all-weather conventional attack (A, D, E, and F models); strategic bombardment (FB-111A); and electronic countermeasures (EF-111A). Presently, there are 401 aircraft operational. Sacramento Air Logistics Center is the primary depot for the F-111.

Six Class A mishaps were forecast for 1984, but the fleet experienced only three. Of these, one was logistics related, one was operations related, and the third was the result of a birdstrike.

The first mishap occurred while a two-ship formation was practicing low level defensive tactics. During a hard turn, the mishap aircraft encountered an engine compressor stall which caused the aircraft angle of attack to increase at a rate beyond the pilot's capability to arrest it. The F-111 departed controlled flight. Although an ejection was attempted, it took place out of the envelope, resulting in two fatalities.

A second F-111 was destroyed during a night terrain following radar (TFR) mission. The mishap crew aborted the low level TFR route for an unknown reason; became distracted and/or disoriented; and entered a rapidly descending, unusual attitude from which they failed to recover. The safety investigation board determined no ejection was attempted.

The third Class A mishap occurred when the aircraft struck a bird on a bomb run at 200 feet and 520 knots. The bird shattered the radome causing flight instruments to fail, both engines to stall and roll back, and the flight controls to malfunction. The crew ejected successfully, but both members received compression injuries during ground impact.

The primary F/FB/EF-111 safety concerns encountered during 1984 were:

■ **TFR** Since the beginning of 1982, two aircraft have been lost because of problems attributed to the TFR system. In both cases, the automatic fly up feature malfunctioned for unknown reasons. TFR malfunctions continued to occur in 1984, many causing frustration because the cause of the problem could not be identified. A Blue Ribbon Panel was formed in January 1983 to investigate TFR system problems and recommend corrective actions. Panel action is ongoing, and two meetings were conducted in 1984 at McClellan AFB CA. Fifty-five action items have been identified, and 11 still remain open. Although the Blue Ribbon Panel has been unable to determine the cause of the problems, their continuing effort represents our best hope to bridge the gap until the F-111 Avionics Modernization Program is complete.

■ **Stabilization Brake Parachute Jettison** During ejection, the crew module recovery parachute (RP) entangled with the stabilization brake parachute (SBP), resulting in unsuccessful RP deployment and unsuccessful ejection. The solution is to incorporate cutters to jettison the SBP from the module during low speed mode ejections. Presently, this safety modification is ahead of schedule. The prototype was completed in September 1984, and kit proofing was begun in December. Installation is scheduled to begin in July 1985 and will take 10 months to complete.

■ **Crew Module Ejection Injuries** Aircrews are experiencing a 30-percent back injury rate during ejection. Crew module dynamic impact tests were conducted in 1984 to evaluate performance of an energy-absorbing seat and a new recovery parachute system. Data obtained from these tests are still under evaluation, but it appears to favor the new recovery chute system.

■ **Pacer 30 Program for TF30** The TF30 engine has major technical deficiencies, and Pacer 30 was established to increase reliability and durability with major modifications to the F-111 engines. These are reliability, not performance modifications. The modified engines will perform as in the past, except longevity will be improved. Pacer 30 provides for the incorporation of over 30 engineering changes for the P-3/-7/-9 engines and over 50 engineering changes for the P100 engines. Oklahoma City ALC began incorporating Pacer 30 on 1 October 1984 for the TF30-P-3/-7/-9. Pacer 30 for the TF30-P-100 will start 1 October 1985. The F-111 engine fleet should be completely modified by the end of FY 88.

The 1984 F/FB/EF-111 Class A mishap rate of 3.1 was the lowest recorded since 1974 and represents the second lowest rate since the aircraft became operational in 1967. This is an excellent achievement and one that clearly reflects a positive safety attitude on the part of all F-111 operators and maintainers. Let's keep the pressure on and strive for a Class A mishap rate of zero in 1985. ■

T-33

MAJOR BOB MULVIHILL, CF
Directorate of Aerospace Safety

■ The T-33 is an aircraft that pilots fall in love with. Ask any old pilot who has flown them, especially if he hasn't flown one for awhile. You'll note a certain glaze in his eye as he utters things like: "A great old bird; A super aircraft for cross-country; A pilot's airplane;" and "They don't make them like that anymore."

Since 1949, United States Air Force T-33's have logged over 17 million hours, and approximately 190 are still in service. The lifetime Class A mishap rate is a whopping 13.78 per 100,000 hours, a legacy from the fifties when losing 300 aircraft each year was not uncommon. Things have significantly improved since then. Over the past 10 years, T-Bird pilots have logged about 600,000 hours with a Class A mishap rate of approximately 3.5 per 100,000 hours.

In 1984, the venerable old T-33 had its best year ever; not one aircraft was lost. It was the first time T-33 operators and maintainers have achieved a perfect record. Unfortunately, in 1985, our good fortune was shortlived. At the time of this writing (February), one pilot had already lost his life, and two aircraft had been lost.

Someone once said that there are no new accidents, just new people. With an aircraft as old as the T-33, this is doubly true. Perhaps, for the new people, a review of some past mishaps will shed light on what they might look for and avoid in the future.

The following facts and comments are a result of a review of 20 of the Class A mishaps which have occurred since 1975.

■ **Mishap Type** Loss of control accounted for 6 of the 20 mishaps. Four others were undetermined, 3 resulted from turbine failure, 3 were

continued

landing mishaps (one long and two short), and 2 involved in-flight fire and/or explosion. If you've been adding up as we go along, you'll know that there are 2 left. One involved low flying, and the other occured when the aircraft struck a mountain during a night IMC departure.

■ **Cause Factors** Of the 16 mishaps that were not classified as undetermined, the operational-related mishaps accounted for twice as many (10) as the logistics-related mishaps. One mishap was both operational and logistics. None of the logistics-related mishaps resulted in fatalities.

■ **Comments** This confirms that you, the operator, have the most control of your fate. Furthermore, the key to reducing mishaps and fatalities is in the hands of T-33 pilots and their supervisors.

■ In the above sample, pilot loss-of-control mishaps lead the pack! The T-33 has several out-of-control modes. It can depart into an upright spin, an inverted spin, an out-of-control spin, or a tumble. Most are avoidable and occur because of excessive side-slip; the T-33 doesn't like excessive rudder inputs. As a T-33 pilot, do you know what your rudder limitations are for different configurations and fuel loads?

■ Once the aircraft departs, are you prepared to recover? Have you considered when you will eject? Good things to know before you ever take off.

■ **Survivability** Ten of the 20 mishaps involved fatalities; a total of 13 pilots lost their lives. Of the 7 mishaps that involved solo pilots, 5 were fatal. Three of these occurred at night, and 2 (both as yet undetermined) involved rapid descents and high impact angles. Two passengers were involved. Both ejected, but the ejections were unsuccessful. In both cases, the front seat pilot made it.

■ **Comments** Unpleasant statistics; not the sort of thing we like to think about. Seems that if you have a mishap when you are solo, the odds are 5-to-2 that you aren't going to survive. The logical conclusion is that a T-33 pilot who is preparing for a solo mission (especially at night) has to do a little extra preparation and fly with greater attention to keep from becoming a statistic.

■ How about that passenger in the back seat? Are you sure he's strapped in properly? Have you discussed what his actions should be in an emergency?

■ If you lost your electrics or your attitude indicator at night, are you confident you could safely recover? When was the last time you practiced unusual attitude recoveries on the dials? Do you always carry a flashlight? If the lights went out, could you find it? At which instruments would you point it?

Let's look at some other 1984 data to see if there is anything that can help us in the future.

There were no Class B mishaps in 1984. Of the 35 Class Cs, 19 involved the engine. Six of the Class C engine mishaps were hot starts. That might be an area to stress in your Dash 1 review. Of the 4 flameouts, only 1 occurred in-flight, although there was 1 partial power loss which resulted in a landing with partially extended landing gear. There were 2 incidents of the engine being shut down inadvertently by the front cockpit pilot's left knee or checklist.

Physiological mishaps accounted for 6 of the Class Cs. This is unusually high, but not unexpected. The T-33 just isn't pressurized like a newer fighter, and a pilot or a passenger with an ill-fitting mask is more apt to have problems. Special attention must be paid to ensure that PE gear is properly fitted, checked, and works correctly. As the T-bird gets older, we can expect more pressurization problems. The key here is to make sure that the problem is identified and corrected before the aircraft goes airborne.

In 1984, T-33 operators and maintainers showed us that they are capable of a 100-percent mishap-free record. The early 1985 experience has graphically shown that we can't afford to rest on our laurels. The T-bird is a fine old aircraft with many years of useful life. Let's resolve to make them mishap-free so the "old girl" can go out in style. ■

A/T-37

LT COL CINC PONERT, GAF
Directorate of Aerospace Safety

■ The year 1984 is history; and here I am again, your Air Force Inspection and Safety Center project officer to wrap up our A/T-37 safety records. The year's changeover provides us with an opportunity to look back, evaluate the success and failure of our endeavors, prioritize new goals, and establish guidelines on how to achieve these goals.

Generally speaking, 1984 was a very successful year for the T-37 trainer aircraft and the A-37 fighter/bomber. Let's take an indepth look at how we did these past 12 months.

T-37

The T-37 trainer aircraft passed the 9 million mark of total flying hours (9,118,537 hours) in 1984, as predicted. That equals an annual average of approximately 350,000 flying hours since it came into the USAF inventory in the late 1950s. This is the second highest number of total flying hours ever achieved by a single fighter/trainer aircraft in USAF history. I have to admit it is pretty tough to beat the good old T-33 (T-Bird) with over 17 million flying hours. But we are still an edge ahead of the F-4 (8.5 million hours) and the T-38 (8.4 million hours).

During this time, we experienced only 126 Class A flight mishaps for an overall rate of 1.38 mishaps per 100,000 flying hours. These figures, however, do not include ground mishaps.

As of 31 December 1984, 648 T-37s still fulfilled the job as highly reliable trainers for undergraduate pilot/navigator training for the USAF and almost all NATO countries at 8 different US bases. In 1984, the fleet logged 323,488 flying hours — approximately 10 percent of the total annual USAF flying time for that period, and the third highest among the trainer/fighter aircraft after the T-38 (approximately 378,000) and the F-4 (approximately 350,000). All people involved in flying activities kept up the professional work, and we had only 1 Class A and no Class B flight mishaps, resulting in a mishap rate of 0.3 (total USAF 1.77) — the same as in 1983.

The following figure shows a summary of Class A mishap rates for the last five years with a distinct downward trend of 4, 2, 2, 1, and 1 mishaps for the respective years. It also gives you a short breakdown in operator and logistics factors.

continued

T-37 Mishap Summary

1980 (4/1.4)	Ops:	solo — loss of control — fatality
	Ops:	solo — collision with ground — fatality
	Log:	solo — engine acc gear failure — ejection
	Ops:	solo — loss of control — fatality
1981 (2/0.7)	Ops:	solo — loss of control — ejection
	Ops:	solo — loss of control — fatality
1982 (2/0.6)	Log:	dual — engine malf— 2 fatalities
	Ops:	solo — loss of control — ejection
1983 (1/0.3)	Ops:	solo — loss of control — fatality
1984 (1/0.3)	Ops:	dual — spin — 2 ejections

T-37 continued

The 1984 mishap involved two instructor pilots. The mishap crew was scheduled to fly a standardization/evaluation spin demonstration mission. During the mission, the aircraft went out of control and the pilots ejected. The aircraft impacted the ground and was destroyed. Both crewmembers sustained minor injuries.

As we see, the operator is still the key factor. But 1984 was also the first year since 1978 without claiming a fatality, and that is what definitely counts too. I might also add a big "Atta Boy" to our solo students for not being involved in a Class A mishap in 1984. By experiencing only one Class A mishap, we almost accomplished our ultimate goal of mishap-free flying. The difference between success and failure in the future is really a very small margin. Thus, predicting one Class A mishap in 1985 appears to be realistic.

To actually improve our overall safety record, however, we have to fight our mishap potentials — the Class Cs and HAPs. During the past year, 211 Class Cs and 39 HAPs were reported from field level activities (254 Class Cs/118 HAPs in 1983). Considering the number and age of aircraft and the total flying time per year, these numbers are not unexpected. Ninety-six (38 percent of the grand total) were engine-related problems for various reasons with 49 (20 percent of the grand total) being engine flameouts. Although we were able to reduce engine flameouts by some 27 percent compared to 1983, they still plague us. Future plans and possible fixes will again be discussed during the next system safety group meeting.

We also noted 59 (24 percent of the grand total) physiological episodes (73 in 1983). Flying with cold symptoms, active airsickness, etc., ranked second after loss of consciousness (GLC) episodes. GLC mainly occurs due to rapid/unexpected onset of G loads, sustained G for relatively long periods of time, and/or improper M1/L1 maneuvers.

Since GLC is an even more important player in the fighter community, being in shape, being prepared, and performing the M1/L1 maneuver properly cannot be overemphasized. (For further details on the Air Force Inspection and Safety Center's ongoing GLC Survey and its preliminary results, refer to Major John Pluta's article in the *Flying Safety* magazine, January 1984, or call him at AFISC/SEFF, AUTOVON 876-3886.)

The T-37 is continually monitored for trends (HBU-12A lap belt slippage, cracks in the banjo fittings, etc.), and many efforts are constantly underway (installation of ARU-42/A-2 standby attitude indicator, exhaust duct modification, engine inducer blades, etc.) to improve its safety and dependability. This discussion has only skimmed the surface of some of the problems in 1984. I leave you with the German saying "HALS UND BEINBRUCH"* for 1985.

*Good Luck

A-37

The last paragraph of my 1983 summary (April 1984, *Flying Safety* magazine) reads:

For 1984 we do not predict any Class A mishaps. We do need, however, to put all our efforts in striving to make this goal of mishap-free flying really happen.

Well, *you did it*.

In 1984, the Air Force experienced its second consecutive *year* (and the fourth out of the last five years) for the A-37 without a Class A or Class B flight mishap. This is indeed remarkable. Since the USAF A-37 fleet accumulated 614,212 lifetime flying hours as of 31 December 1984, the overall mishap rate dropped from 5.3 at the end of 1983 to 5.0 at the end of 1984. The rate reflects a total of 31 Class A mishaps since the early Seventies when the A-37 entered the USAF inventory. The fleet increased its flying time from 28,218 hours in 1983 to 30,303 in 1984, with a total of 119 aircraft. The users and their respective missions remained unchanged.

The following is a review of the Class Cs with HAPs for the past year with highlights of a few problems areas.

- The total number of C/HAPs was reduced from 79 (77/2) in 1983 to 63 (56/7) in 1984. Thirty-nine (63 percent of the grand total) were engine related, with 17 (29 in 1983) being engine flameouts. Although several approaches have been attempted to fix this problem, no final solution has yet surfaced. This will also be an agenda item for the next system safety group meeting at SA-ALC, Kelly AFB TX.

■ In one Class C mishap, the nose gear torque link quick release pin fell out due to vibration while aborting the takeoff for a nose tire failure. Replacing this pin with a so-called diaper pin will correct the deficiency. As of October 1984, modifications had been made on 62 aircraft.

■ The illumination of the left fire warning light on three separate occasions during a recent two-month period resulted in a possible problem on several 70-series A-37 aircraft at that particular unit. A project was established in October 1984 to determine the reason for the fire lights. Completion of the engineering study was scheduled for January 1985.

■ Another incident (illumination of fire warning light) resulted in an inspection of all J85-17 tailpipes by the manufacturer to determine if they met design specifications before issuance to the field.

■ The Class IV A safety modification to install a low pressure relief valve in the oxygen system has been approved. The delivery of production kits for the relocation of flight instruments for a better cross-check was scheduled for November 1984.

■ Improvements are constantly ongoing. It is up to you to make 1985 the third consecutive mishap-free flying year for the A-37 fleet and . . . watch out for complacency!! ■

T-38

MAJOR JIM TOTHACER
Directorate of Aerospace Safety

■ The T-38 Talon has gained countless nicknames since it started logging time with the USAF 25 years ago (1960). Some who earned their wings in the lightweight jet call it the "white rocket;" some call it the "white mouse;" while others refer to it as the "sports model" of military aircraft. Perhaps all would agree it's a clean airplane with an earned reputation for reliability and safety — two aspects vitally important to its principal role as the advanced trainer in undergraduate pilot training.

Since its introduction, the T-38 has experienced a total of 168 Class A mishaps through 1984. These mishaps have resulted in the destruction of 161 aircraft and the loss of 67 aircrew. With over 8.5 million hours flown, this translates to a remarkably safe Class A mishap rate of just under 2.0 per 100,000 flying hours.

The number of operations-related

continued

T-38 continued

mishaps is almost double that of logistics-related mishaps. Of the 168 total Class A mishaps, 101 qualify as operations related compared to 55 logistics-related mishaps. The remaining 12 mishaps are classified as undetermined or miscellaneous.

In 1984, we experienced three Class A mishaps in the T-38. True to form, two were operations related, and the third was logistics related. These mishaps caused the destruction of four aircraft and the loss of five aircrew members. A brief review of the 1984 Class A mishaps follows.

■ The mishap sortie was a four-ship formation training sortie. During a tactical rejoin, Numbers 3 and 4, both dual, collided. The collision resulted in three fatalities, and the fourth aircrew member sustained a significant back injury.

■ The mishap aircraft was scheduled to fly as the bandit in a three-ship air combat maneuvering sortie. On the third engagement, the pilot of the mishap aircraft, in a hard right turn, felt and heard a rumbling noise. Just a few seconds after the pilot called "knock it off" and rolled wings level, the aircraft began an uncommanded violent negative G pitchover. Unable to sustain aircraft control, both crewmembers ejected successfully, but the front seat pilot incurred major injuries on his parachute landing fall. The horizontal stabilizer had failed and departed the aircraft, and the aircraft was destroyed by ground impact.

■ The mishap occurred during the base turn for a full-stop landing on the final leg of a cross-country training mission. The mishap pilot overshot the turn and attempted to correct back to the final approach course. The aircraft was destroyed as it impacted the ground short of the approach end of the runway. Neither crewmember ejected, and both were fatally injured.

The big news of the year for the T-38 was the decision to extend its service life beyond the year 2000. As you might expect, to keep the T-38 as a viable asset into the 21st century, extensive modifications will be made. The modifications come under the package title "PACER CLASSIC." "PACER CLASSIC" program changes are required to sustain the T-38 weapon system operation until 2010 and to modernize the current configuration to improve safety, maintainability, and reliability.

Some "PACER CLASSIC" initiatives are improved main and afterburner fuel controls, a new attitude and heading reference system, auxiliary air intake doors for increased engine thrust on takeoff, an improved flap-slab interconnect cable incorporating a redundant system, stage one and two compressor blade redesigns, a new standby attitude indicator, state-of-the-art ILS equipment, and a more reliable IFF. This is only a partial list of numerous modifications.

As you can see, no effort is being spared to make the machine meet the safety challenge presented by extended life. Likewise, we must spare no effort in reducing the human elements involved in flight mishaps. Human factors considerations are required in every mishap prevention program. We all can help by recognizing our daily changing limitations, and maturely operating within them.

The T-38 has served the Air Force well and will continue to do so. Let's make sure we serve ourselves well by recognizing and coping with that single factor that contributes the most to Air Force mishaps — that we are, after all, human. ■

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What Your Manuals Didn't Tell You . . .

ABOUT AIRCRAFT TIRES

MAJOR RONALD K. SCOTT
Directorate of Aerospace Safety

■ A review of several different fighter and cargo aircraft flight manuals highlights numerous operational limitations of the weapon system. Items such as engine, center of gravity, flap, landing gear, and brake limitations are almost universally addressed. However, very few flight manuals have any guidance on tire limitations. A casual observer may see no need for any limitations since the tires are significantly larger and stronger than any automotive tires we are accustomed to seeing.

Although the trade names and basic composition of aircraft and automotive tires may be the same, the design approach is totally different. Design parameters on automotive tires call for a tire that will withstand continuous use with 12- to 17-percent deflection. Aircraft tires are designed for rugged intermittent use at 32- to 35-percent deflection.

Two flight manuals that do discuss tire limitations are for the F-111 and the KC-135A.

A tire limitation in the F-111 flight manual illustrates this point: "Continuous operation of the aircraft is restricted should the total taxi distance of 30,000 feet be reached. . . . Taxi distance includes takeoff and landing rolls. If the distance limitation is exceeded, the aircraft must be parked to allow the tires to cool. . . ."

The KC-135A flight manual presents even a better discussion of tire heating. For example: "The structural integrity of the tires is seriously affected if the tire temperature exceeds 120° C (248° F). Tire heating during taxi may be three times the tire heating during a normal takeoff roll. . . . Generally, the tire temperature increases about 20° C (68° F) per nautical mile of taxi distance. . . . *Caution:* The taxi distance should be limited to 5 nautical miles to prevent exceeding the tire temperature limit."

The C-130 weapon system does not include tire limitations in the flight manual; however, the tire design specification reiterates the "intermittent usage" engineering design for aircraft tires. The specification calls for a tire that will withstand the following:

- 130 taxi/takeoff cycles (24,950 feet roll per cycle).
- 130 landing/taxi cycles (19,740 feet roll per cycle).
- 60 taxi cycles (2,300 feet roll per cycle).

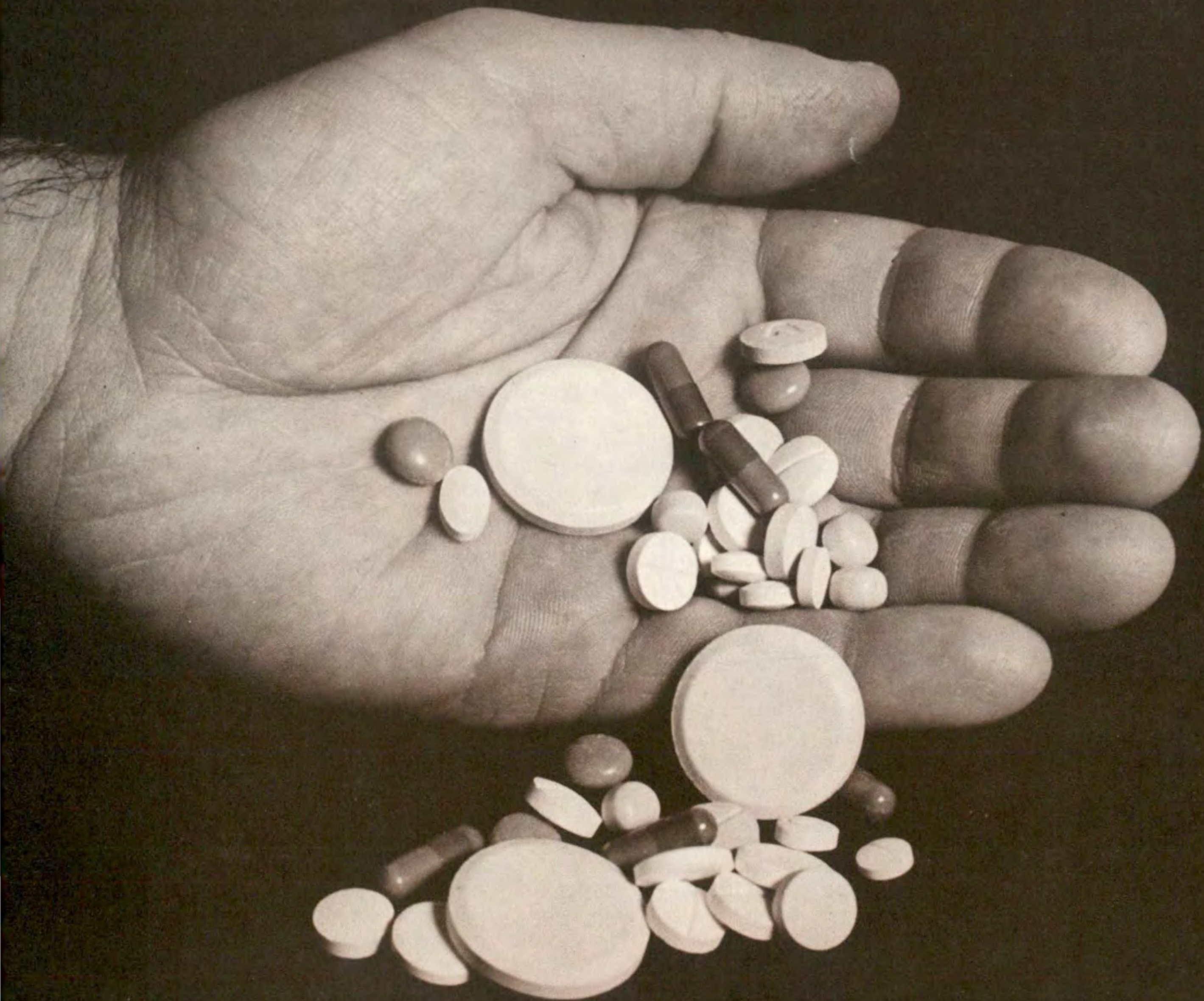
The tire temperature limits depend upon several factors that involve intermittent tire loading such as aircraft gross weight, taxi distance and speed, surface temperature, amount of brake use, amount of turning necessary, relative smoothness of the taxi surface, and inflation pressure. Exceeding the tire temperature limits by any one or a combination of those actions does not necessarily cause immediate failure. The structural integrity is weakened, so one could expect premature sidewall failure or tread separation either immediately or on a subsequent mission.

Data reported to the Air Force Inspection and Safety Center in the form of Class A, B, or C mishaps and materiel deficiency reports established very predictable failure rates. We have experienced between 6 and 12 tire failures per 100,000 flying hours.

Armed with the proper information and historical patterns, planners can consider tire capabilities when developing the local operating procedures. For example: Is there a sufficient cooling period after C-130 windmill starts? Should there be a tire cooling period after extended F-4 taxi checks? Do normal training or airfield traffic procedures require excessive taxi distances for A-7 or A-10 units?

If your organization should become aware of new information on specific limitations, contact the MAJCOM safety office or system program manager. The addition of a short discussion on tire limitations in your flight manual is a small investment when it comes to landing and takeoff "pucker factor" relief. ■

CURE OR KILL?



In 1984: 2 Class A Mishaps — 2 Fatalities

Don't SELF-Medicate