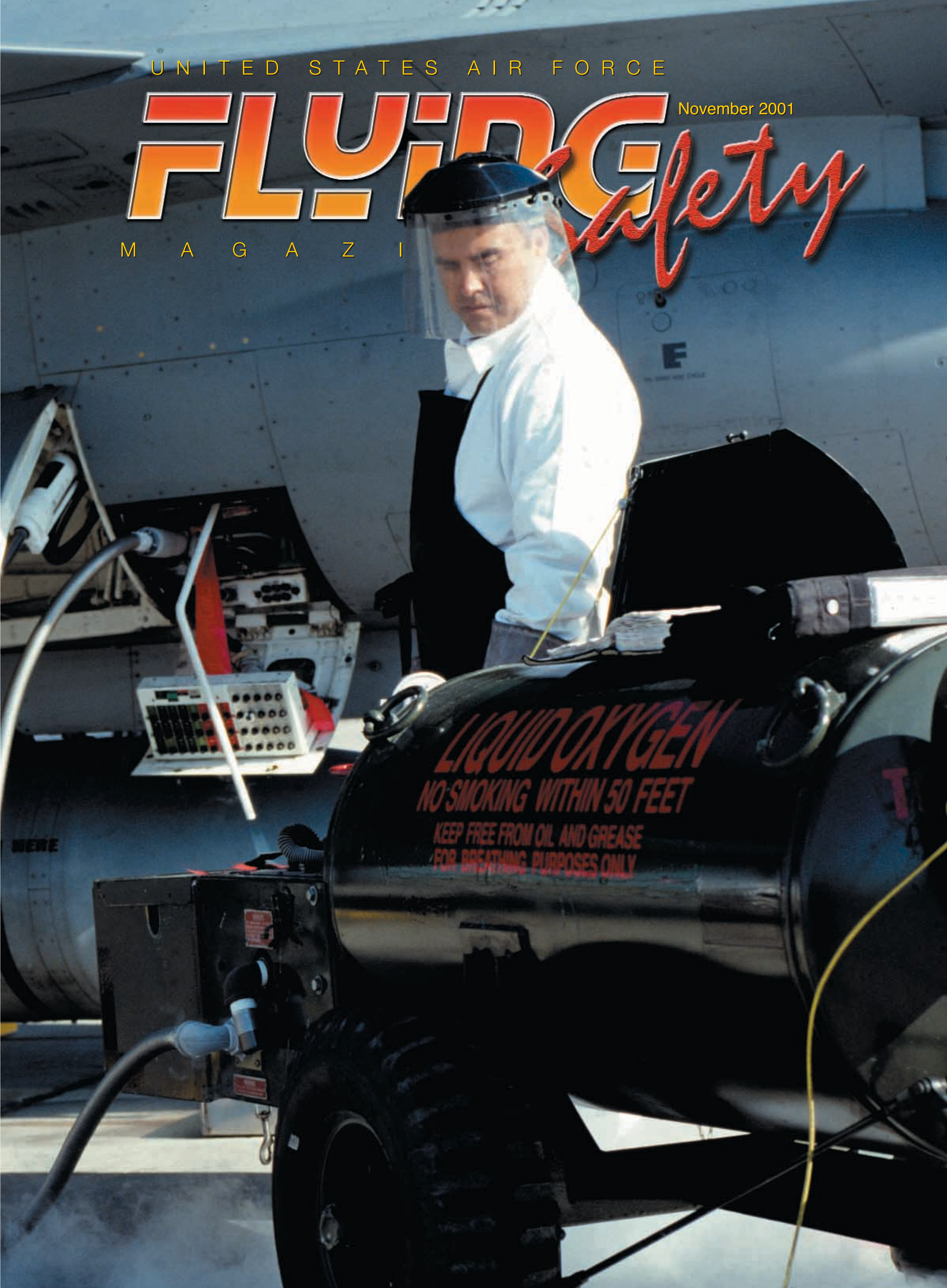
UNITED STATES AIR FORCE

FLYING Safety MAGAZINE

November 2001



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FLYING Safety

MAGAZINE

4

14

20

HQ AFSC Photo by TSgt Michael Featherston

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

PURPOSE — *Flying Safety* is published monthly to promote aircraft mishap prevention. Facts, testimony, and conclusions of aircraft mishaps printed herein may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. The contents of this magazine are not directive and should not be construed as instructions, technical orders, or directives unless so stated. SUBSCRIPTIONS — For sale by the Superintendent of Documents, PO Box 371954, Pittsburgh PA 15250-7954. REPRINTS — Air Force organizations may reprint articles from *Flying Safety* without further authorization. Non-Air Force organizations must advise the Managing Editor of the intended use of the material prior to reprinting. Such action will ensure complete accuracy of material amended in light of most recent developments.
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FSM notams

Maintaining Safety Awareness in Our Challenging and Evolving Operational Environment

Our mission at the Air Force Safety Center is to establish and execute mishap prevention programs to enhance Air Force mission capability. It is our sincere hope that our philosophy pervades the Air Force in the days to come.

The mission is paramount—the trick is to do it as safely as possible. We truly believe people are the Air Force's most valuable resource and that a single death or injury—on or off duty—is one too many. Air Force weapon systems are more costly and harder to come by than ever. We can ill afford loss or damage that impacts our combat capability.

The temptation during times of increased tension, tempo and operations is to take shortcuts, ignore the rules and just get the job done. "We're in a fight now and we can ignore the rules." Wrong! We always say we should train like we fight; let's not throw out the rules and safety programs we live with every day. Continue the mishap prevention program we have in place. Use operational risk management. Minimize our risks and potential losses to preserve resources and fight another day. We can't afford another Bien Hoa, South Vietnam, where we lost 14 aircraft, 28 people killed, and 105 wounded due to an explosive mishap or a Doha, Kuwait, where the Army suffered more losses in one explosive mishap than their total combat losses. In Desert Storm, flightline safety issues were encountered at Prince Sultan. In other places such as Tusla and Tirana, safety issues were encountered at the outset of operations there.

We have seen non-combat losses and injuries at the beginnings of operations, and even one is too many. We work hard every day across the Air Force to have an effective mishap prevention program, to preserve lives and resources. Whatever the challenges are, now is the time to pay attention to the safety programs, mishap prevention plans and risk management initiatives we have put into practice.

Our mission here in the Education and Media Division at the Air Force Safety Center is to assure effective mishap prevention programs Air Force-wide. We do this through effective education and training and publication of world-class safety and mishap prevention magazines. Our ultimate goal at Flying Safety magazine is to enhance the preservation of combat capability.

Thanks for your help!

MARK K. ROLAND
Chief, Education and Media Division
Editor-in-Chief

F-15 Class A Ground Mishap: An AIB Report Synopsis

CHIEF MIKE BAKER
HQ AFSC/SEMM

USAF Photo
Photo Illustration by Dan Harman

The aircraft was towed with munitions loaded and the aircraft arresting hook was in the slung position.

Class A Mishap: A mishap resulting in one or more of the following: Total mishap cost of $1,000,000 or more; A fatality or permanent total disability; Destruction of an Air Force aircraft. (AFI 91-204, *Safety Investigations and Reports*, paragraph 3.2.2.1.)

What you're about to read was extracted from the AIB Report of a Class A Mishap, so the information isn't "confidential" and we aren't breaking any promises of safety privilege. We have edited some of the verbiage from the Report to make for an easier read, but haven't altered any of the AIB Report facts. Ed.

Investigating Class A Mishaps

Barring an exceedingly rare set of circumstances, when the US Air Force suffers an aircraft Class A mishap, two major types of investigations will take place. The first investigation, governed by AFI 91-204, *Safety Investigations and Reports*, is the convening of a *Safety* Investigation Board (SIB). Air Force Instruction 51-503, *Aircraft, Missile, Nuclear and Space Accident Investigations*, is the governing AFI for the second type of investigation, the *Accident* Investigation Board (AIB).

"But why," you ask, "would two separate boards investigate the same mishap?" Here's why. An SIB's primary purpose is to investigate the mishap, determine cause(s) and *make recommendations to prevent a similar mishap from occurring again*. SIB Reports are used *solely* for mishap prevention, contain privileged information and are not prepared for public release. On the other hand, the primary purposes of an AIB are to gather and preserve evidence for—among other things—claims, litigation and "all other purposes," and to provide a statement of opinion, through a releasable report, *on mishap cause(s), or factors that substantially contributed to the mishap*. Even though there may be some overlap in the SIB and AIB investigations for a single Class A mishap, the boards don't "share" members, and each board conducts its own, impartial mishap investigation. Here are the main points to remember:

- The SIB's objective is *mishap prevention*. The SIB Report is a "safety animal" that *is* privileged.
- The AIB *gathers evidence* and *explains what happened*. The AIB Report is a "legal animal" that is *not* privileged.

Accident Summary

At 0123L on the mishap date, a ground run crew was performing an operational check of the No. 2 engine afterburner spray ring on the F-15 mishap aircraft (MA) inside a Hush House. Approximately four seconds after the mishap engine operator (MEO) advanced the No. 2 throttle to afterburner, the MA's arresting hook became disconnected from the holdback assembly. The MA moved rapidly forward, and slightly left, penetrating the Hush House doors. Immediately after impact the MEO shut down both engines. The MEO and mishap backseat observer (MBO) safely egressed the aircraft. The mishap ground man (MGM) and mishap console operator (MCO) safely egressed the Hush House. The MEO sustained minor injuries. The forward third of the MA, both engines, the right external tank, nose gear, engine inlet variable ramps and canopy were significantly damaged. The impact also caused extensive damage to the Hush House doors.

The Circumstances

On the day before the mishap, day shift workers removed and replaced the afterburner spray ring on the MA's No. 2 engine. After the spray ring was replaced, maintenance personnel annotated the requirement for a leak test prior to flight in the aircraft forms. This test was required to return the MA, scheduled to fly the next day, to fully mission capable (FMC) status. In accordance with tech data, the checkout involved an accel/decel engine run. A run crew was tasked to perform necessary testing in the Hush House.

At approximately 2330L, the swing shift APG Expediter directed the MEO to tow the aircraft from its parking spot to the Hush House. The APG Expediter told the MEO the aircraft was ready to be towed and that he had previously obtained tow clearance. The MEO erroneously assumed pre-tow preparations had been completed. The APG Expediter drove the MEO to the MA parking spot. A tow team was already there, attaching a tow vehicle to the aircraft. The tow team was comprised of one person in the cockpit to monitor the aircraft brakes, two wing walkers and one tow vehicle operator. The person monitoring the brakes was the MBO. The MEO was acting as the tow team supervisor. Prior to tow, the MEO did not complete the pre-tow and hangaring checklist. The aircraft was towed with munitions loaded and the aircraft arresting hook was in the slung position.

The tow was uneventful, and at approximately 2350L, the aircraft arrived at the Hush House. Within minutes, the MCO arrived at the Hush House. The tow team backed the aircraft into the Hush House, with the MCO acting as the tail walker. During positioning of the aircraft, the MCO noticed the aircraft was configured with munitions. Once the aircraft was in position, the MCO informed the tow crew the aircraft could not be run with munitions loaded. At this time, the swing shift APG Expediter and the midnight shift APG Expediter arrived at the Hush House. Everyone agreed that the chaff/flare modules, BDUs and all cartridges had to be removed. There was a discussion about whether the captive AIM-missile needed to be removed. The MCO went to get his supervisor from the Test Cell to help resolve the issue. The group eventually agreed the captive AIM-9 also had to be downloaded.

The team towed the aircraft out onto the Hush House apron and called the Munitions Expediter to arrange for download of the munitions. A swing shift crew downloaded the chaff/flare modules, BDUs and all cartridges. This crew then returned to their duty section to complete shift changeover with the midnight shift weapons crew. The midnight shift crew then downloaded the captive AIM-9 missile. During the weapons download, the MGM arrived at the Hush House. At approximately 0100L, the munitions team finished downloading the aircraft and the aircraft was ready to be towed back into the Hush House.

The aircraft tow team—which now included the MEO, MCO, MGM and MBO—again repositioned the MA into the Hush House. The tow vehicle driver and the MBO prepared to depart, but before they left, the MEO asked the MBO if he would like to sit in the back seat during the engine run. The MBO accepted.

After an aircraft was chocked in the Hush House, the MCO would normally

continued on next page

The mishap aircraft moved rapidly forward, and slightly left, penetrating the Hush House doors.

connect the aircraft arresting hook to the holdback assembly. On this occasion, he didn't reconnect the arresting hook after the aircraft was chocked because he wanted to verify that all munitions were downloaded. He also wanted to check the aircraft forms to see if there were any other conditions that would prevent the engine run. After a prolonged aircraft forms review, he verified there were no outstanding maintenance conditions that would prevent the engine run.

The MEO informed the MCO which tech order (T.O.) they would be using for the accel/decel test. The MCO agreed to read the T.O. steps to the MEO during the engine run. The MCO briefed the MGM on fire and evacuation procedures. The MEO walked around the aircraft, closed panels and looked into the aircraft intakes. The MEO did not complete prior-to-engine-run intake inspections. MEO stated he knew the intakes had been inspected earlier and intake covers had been installed. The MBO climbed into the aircraft rear cockpit followed by the MEO into the front aircraft cockpit. The MGM manned the fire bottle and the MCO manned the console.

"...Hey, how's this pin go?" "What pin?"

The Engine Run

The MEO started the jet fuel starter (JFS). The MEO, MCO, MGM, MBO established good communications.

The MEO then started the No. 2 engine. Shortly after engine start, the MGM noticed the arresting hook rising and asked the MEO to lower it. At this point, knowing the arresting hook was not connected to the holdback assembly, the MEO should have shut down the engine; however, the MEO continued the engine starting procedures. The decision to continue the starting procedures may have been influenced by the MEO's certification course, which required an out-of-sequence engine start. The MGM was not sure, but the hook may have lowered directly on top of the arresting gear yoke as depicted in re-enactment photos.

After the No. 1 engine was started and the JFS shut down, the MGM began connecting the aircraft arresting hook to the holdback assembly. According to the MEO, the following communication transpired:

- MGM: "...Hey, how's this pin go?"
- MEO: "What pin?"
- MGM: "The big pin, it's not going in right...I'm not sure...I'm gonna ask the Hush House guy [referring to the console operator]."

The MCO then gave verbal instructions to the MGM on how to connect the holdback assembly to the aircraft arresting hook. The MGM attempted the connection and subsequently became frustrated with the procedure. The MGM went to the console window, with the quick-disconnect pin in hand, to show to the MCO. The MCO disconnected his communications cord and went into the bay to help the MGM.

According to the MCO and MGM, together they inserted the quick-disconnect pin. Before departing from beneath the aircraft, the MCO disconnected the arresting hook sling, dangling from the arresting hook recess, and returned to the console room. While the MCO was en route to the console room, the MEO asked the MGM three times if the connection was good, and each time the MGM said "yes."

After the MCO re-established communication, the MEO proceeded to tension the holdback assembly. The MGM properly re-positioned the aircraft chocks behind the main gear after the holdback assembly was taut. *(Note: At this point there are no chocks in front of the main gear IAW tech data.)* After the wheels were chocked, the MGM disconnected his headset and joined the MCO in the console room.

The accel/decel engine test proceeded uneventfully until the No. 2 engine throttle was advanced to MAX power. After approximately four seconds, the aircraft arresting hook disconnected from the holdback assembly. The aircraft began to move forward and to the left. The MCO said, "Hey man, you broke away! Cut your throttle!" The MEO was focused on his gauges and did not initially realize the aircraft was moving. The MA moved forward approximately 43 feet and stopped as it impacted the Hush House doors at 0123L. After impact, the MEO shut the engines off. Fuel began to leak from the aircraft and there was some smoke in the Hush House. The MCO attempted to contact the fire department.

Two workers from the nearby Test Cell heard the impact and ran to the Hush House. One worker helped the MEO and MBO egress the aircraft. The other worker ran into the Hush House, informed the MCO the fire department had been notified and told the MCO to get out. The MCO and the Test Cell worker exited the Hush House. The MEO, MBO, MGM, MCO and the two Test Cell workers all waited at a safe distance from the Hush House.

Security forces arrived at 0127L, and immediately set up a 300-foot cordon and established an Entry Control Point. The fire chief arrived at 0137L. The fire department proceeded to clean up the fuel spill.

Mishap Ground Crew (MGC) Qualifications and Medical Assessment

• The MEO was fully qualified and current to perform engine run duties in the Hush House.

• The MGM was a fully qualified and current engine run operator and ground man. The MGM stated he was performing ground duties in the Hush House for the first time.

• The MCO was fully qualified and current to perform Hush House console operator duties. He received on-the-job (OJT) training to connect the aircraft arresting hook to the holdback assembly.

• The MBO was not an active participant in the mishap. He was qualified to sit in the rear cockpit.

Review of medical and dental records of the four MGC members indicates they were medically qualified for duty at the time of the accident. Review of medical records and interview of each MGC member indicated there were no significant pre-existing diseases. The MEO suffered a minor left shoulder strain and minor hand abrasions as he egressed the aircraft. He fully recovered from these injuries within three days of the mishap. There were no other injuries and no lost duty days.

Air Force Institute of Pathology toxicology reports on all four MGC members were negative for medications, illicit drugs and alcohol. Based on interviews with supervisors, family members and associates, there was no evidence of any unusual habits/behavior, chronic fatigue or abnormal stress associated with any of the MGC members. There were no problems or peculiarities with diet, alcohol or medication. Based on 72-hour histories obtained from each MGC member, they all received adequate rest prior to the mishap. MGC members were all within their 12-hour maximum duty day.

Maintenance Operations and Supervision

The MGC was experienced and qualified with adequate time to complete the engine run. Ops Tempo was not a contributing factor to this mishap. Supervisors on duty at the time of the mishap included the Pro Super, the APG Expediter, the APG Element Chief and the Test Cell Supervisor. These supervisors were not at the Hush House at the time of the mishap since the MGC was qualified and experienced. Supervision was not a contributing factor to this mishap.

Mishap Cause

Visual inspection of the aircraft arresting hook and holdback assembly showed no evidence of material failure. Mishap photos taken immediately after the accident revealed the holdback assembly was intact and closed, with the quick-disconnect pin properly inserted. The aircraft arresting hook and holdback assembly did reveal scarring consistent with an improper connection.

The AIB team re-enacted the mishap scenario. An F-15 was positioned in the Hush House and connected to the holdback assembly as depicted in re-enactment photos. Tension was applied to the holdback assembly by manually moving the aircraft forward. No load was applied and aircraft engines were not running. This re-enactment confirmed that tension could be applied to the holdback assembly with the arresting hook improperly seated on top of, and behind, the arresting gear yoke.

Human Factors Contributing to the Mishap

Several human factors contributed to this mishap. The first two substantially contributed to the mishap.

• **Habit Pattern Interruption**. The MA was towed and placed into the Hush House with munitions on board. Had the MA been properly configured, the normal sequence would have been to release the arresting hook and connect it to the holdback assembly. The MCO asked the tow supervisor to remove the MA from the Hush House in order for the munitions to be downloaded. After the MA was towed out of the Hush House and the munitions downloaded, the MA was again backed into the Hush House and chocked. Testimony revealed

continued on next page

The walkaround, coupled with a prolonged review of the aircraft forms, interrupted the MCO's habit pattern.

By fixating on the single task of inserting the quick-disconnect pin, the MCO did not pay attention to the overall task.

that the MCO was still concerned that munitions were on board the aircraft and subsequently conducted a walkaround to verify all munitions were downloaded. After the walkaround, the MCO proceeded directly to the console room to review the aircraft forms. Since the aircraft was not properly configured when it arrived at the Hush House, the MCO was concerned that the aircraft forms would reveal additional maintenance discrepancies that would prevent the engine run and require the aircraft, once again, to be towed out of the Hush House. The walkaround, coupled with a prolonged review of the aircraft forms, interrupted the MCO's habit pattern, resulting in the aircraft arresting hook not being connected to the holdback assembly until after the engines were started.

• **Channelized Attention**. This term is defined as "focusing of conscious attention on a limited number of environmental cues to the exclusion of others of subjectively equal, higher, or more immediate priority." It may best be referred to as "fixation." After the No. 2 engine was started, the aircraft arresting hook began to rise, confirming that (1) both front and rear cockpit hook switches were in the "Up" position, and (2) the aircraft arresting hook was not connected to the holdback assembly. The MEO immediately placed the front cockpit hook switch to the "Down" position, at which time the MGM began connecting the aircraft arresting hook to the holdback assembly. During the holdback assembly connection, the following communication transpired between the MGM and the MEO. *Note*: The MCO was monitoring the conversation from the console room:

• MGM: "...Hey, how's this pin go?"

• MEO: "What pin?"

• MGM: "The big pin, it's not going in right...I'm not sure...I'm gonna ask the Hush House guy [referring to the console operator]."

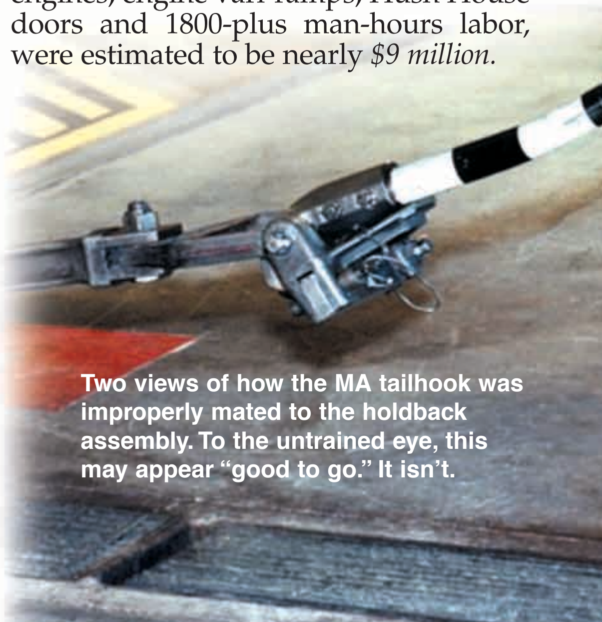
The MGM removed the quick-disconnect pin and brought it over to the console window to show the MCO. The MCO left the console room and entered the Hush House bay to assist the MGM. Testimony confirmed that the MCO was solely focused on properly inserting the quick-disconnect pin that holds the retaining bar in place. This channelized attention stemmed from the MGM's communication that he needed help with inserting the quick-disconnect pin. By fixating on the single task of inserting the quick-disconnect pin, the MCO did not pay attention to the overall task of ensuring the aircraft arresting hook was properly seated in the holdback assembly.

• **Lack of Experience.** The MGM testified that he had no experience connecting the aircraft arresting hook to the holdback assembly. When the MGM attempted to make the connection, he became frustrated and asked the MCO for assistance. *Note*: The MGM was a qualified and current engine run operator, responsible for proper aircraft restraining procedures.

• **"Copilot Syndrome."** Although this term usually applies to mishap aircrew members, it is applicable to the MGC. It describes "an attitude resulting in ineffective crew coordination based on the comforting premise that one or more other crewmembers have the situation under control and are looking out for your best interest." The MEO knew the MGM was a qualified engine run operator and believed the MGM was fully capable of performing the connection. Even when the MGM had difficulty placing the pin in the assembly, the MEO was convinced a proper connection had taken place after the MCO assisted the MGM. The MGM informed the MEO that it was "good to go." Based on that assurance, the MEO proceeded with the full engine run profile.

Mishap Repair Cost Estimates

Aircraft damage was extensive. Total damage costs, which included much of the forward aircraft structure, nose landing gear, canopy, an ejection seat, both engines, engine vari-ramps, Hush House doors and 1800-plus man-hours labor, were estimated to be nearly *$9 million.*



Two views of how the MA tailhook was improperly mated to the holdback assembly. To the untrained eye, this may appear "good to go." It isn't.

USAF Photos

Compare these two views of a properly mated tailhook and holdback assembly to the improperly mated examples below.

Total damage costs were estimated to be nearly $9 million.

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STATEMENT OF OPINION

"Under 10 U.S.C. 2254(d) any opinion of the accident investigators as to the cause of, or the factors contributing to, the accident set forth in the accident investigation report may not be considered as evidence in any civil or criminal proceeding arising from an aircraft accident, nor may such information be considered an admission of liability of the United States or by any person referred to in those conclusions or statements."

The accident was caused by failure to properly connect the holdback assembly to the aircraft arresting hook. There were five factors that substantially contributed to this accident.

Cause. The accident was caused by failure to properly connect the holdback assembly to the aircraft arresting hook. Several pieces of evidence point to this conclusion.

• First, there are only two ways to remove the arresting hook from the holdback assembly if they are properly connected: a) Material failure, or b) Removal of the quick-disconnect pin, then opening the holdback retaining bar. Neither the holdback assembly nor the arresting hook showed any evidence of material failure. This was confirmed by visual examination and NDI of the aircraft arresting hook and holdback assembly. It was also ruled out that the holdback assembly was opened. Mishap photographs clearly showed the holdback assembly was intact with the quick-disconnect pin properly inserted. Given no material failure, and the holdback assembly was intact and pinned, the only possible explanation is that the hook was not properly connected to the holdback assembly.

• Second, the holdback assembly and arresting hook each had distinctive scars consistent with improper seating of the hook in the holdback assembly. These scars were clearly visible in close-up photos of the holdback assembly and arresting hook.

• Third, and finally, re-enactment of the suspected improper connection confirmed it would, in fact, hold the aircraft at the tensioned position.

Based on the evidence, the arresting hook was not properly connected to the holdback assembly. Therefore, when the MEO selected maximum afterburner, the arresting hook disconnected from the holdback assembly and the unrestrained aircraft moved forward and impacted the Hush House doors.

Factors. Five factors substantially contributed to the accident.

Factor 1: Failure To Follow T.O. Procedures/Regulatory Guidance. Failure to follow tech data and regulations did not, of itself, cause the accident, but a series of eight violations set the stage for unsafe operations.

• Violation 1: The tow supervisor, who was also the MEO, did not complete a pre-towing and hangaring checklist IAW the local OI. Completion of this checklist would have identified munitions were on the aircraft prior to tow.

• Violation 2: The aircraft munitions were downloaded on the apron directly in front of the Hush House in violation of AFMAN 91-201, *Explosives Safety Standards*, and the local OI.

• Violation 3: Prior to engine run, the MEO completed and signed the aircraft forms 781A post-intake inspection, in violation of T.O. 00-20-5, *Aerospace Vehicle Inspection and Documentation*.

• Violation 4: Prior to engine run, the MEO did not perform either engine intake inspection, in violation of F-15-specific tech data and the local OI.

• Violation 5: The MEO, MGM and MCO failed to ensure the holdback assembly was properly connected to the aircraft arresting hook as depicted in F-15-specific tech data.

• Violation 6: The MEO started the engines prior to the arresting hook being connected to the holdback assembly in violation of F-15-specific tech data.

• Violation 7: The MEO did not ensure the front and rear cockpit tailhook switches were properly positioned prior to engine start in violation of F-15-specific tech data. This violation resulted in the arresting hook raising after the No. 2 engine was started.

• Violation 8: The holdback assembly was missing the engine run-up arresting gear retaining U-bolt. The missing U-bolt was not documented on the AFTO Form 244, *Industrial/Support Equipment Record*, in violation of T.O. 00-20-5. The U-bolt's function is to serve as a handle to help position the holdback assembly for connection to the aircraft arresting hook. *Note*: The U-bolt serves only as a handle to position the holdback assembly and does not hold the arresting hook in place.

Factor 2: Habit Pattern Interruption. The MCO's normal habit pattern is to connect the holdback assembly to the arresting hook immediately after positioning the aircraft in the Hush House. On the night of this accident, his habit pattern was interrupted by the arrival of the aircraft with munitions still loaded. The aircraft needed to be towed out of the Hush House for downloading of the munitions. After the aircraft was repositioned, a subsequent walkaround and prolonged forms review distracted the MCO from restraining the aircraft until after engine start. The interruption of his normal habit pattern contributed to the improper connection of arresting hook to holdback assembly.

Factor 3: Channelized Attention. When the MCO and MGM connected the holdback assembly, each was fixated solely on inserting the quick-disconnect pin. By channelizing their attention on this task, they did not pay attention to the more important task of ensuring the arresting hook was properly seated in the holdback assembly.

Factor 4: Established Practice. Technical orders require the engine operator to connect the holdback assembly to the arresting hook, but the established practice at the mishap base is for the console operator to make the connection. On occasion, the ground man or a member of the tow team accomplishes the connection. The drawback of this practice is that the responsible, formally trained individual (i.e., the engine operator) is not the one accomplishing the task. This issue is directly related to the training issues discussed below.

Factor 5: Training. There are deficiencies in the formal training of engine run operators and the informal training of console operators.

• **F-15 Engine Run Certification Course**. Students are directed to read the entire F-15-specific T.O., which includes holdback assembly connection procedures. On the final day of class when students are certified in the Hush House, the instructor can either demonstrate the connection procedure, or require his students to perform the procedure. Connection procedures are not specifically covered in the academic portion of the class and the students are not required to perform a proper connection in order to be certified. The MGM, a certified engine run operator, attended formal engine run training on two separate occasions at the mishap base. In each class, he was never tested on the connection procedure and was never required to demonstrate a proper connection.

• **Console Operator, On-The-Job Training (OJT)**. In practice, console operators at the mishap base are performing most of the holdback connections but have no formal training. They receive OJT on how to properly connect the holdback assembly to the aircraft arresting hook; however, this training is not required by regulation, is not documented on the AFTO Form 623 training record and does not utilize a step-by-step technical order or job guide.

Conclusion. This accident was the result of a failure to properly connect the holdback assembly to the aircraft arresting hook. The five factors listed above substantially contributed to the mishap.

Signed this day:
(DATE)

(AIB PRESIDENT'S NAME), Colonel, USAF
President, Accident Investigation Board

Some Final Comments

We *didn't* publish this to salt the wounds of those involved. We *did* publish it so that you—the front line troop, the supervisor, the maintenance superintendent/supervisor—can learn from the misfortune of others. Where it occurred is irrelevant, as are the names of those involved. What is relevant is this: You've now been given the "what happened," as determined by an Accident Investigation Board. *Learning* from what happened, and *preventing* a similar event from taking place in your unit is what this is all about. 'Nuff said.

Just Another Spin?

USAF Photo
Photo Illustration by Dan Harman

This autorotation became the seventh documented case in the T-37 in the past ten years.

LT COL GREG DAVIS
89 FTS
Sheppard AFB TX

In May 2000, a young captain at Laughlin AFB experienced a very different view of the T-37 and the way it flies through the air.

Picture in your mind the nose of the aircraft 50 degrees high, in 90 degrees of left bank, and the airspeed decreasing through 150 knots. The mishap aircraft (MA) was flying formation on the wing of another T-37, and just as the formation reached its apex the MA's student pilot flew a little too close for the MA instructor pilot's comfort level. Being a good IP, he took the jet and began to break out from the fingertip position. The IP's initial move was a roll away from lead, which went okay through the first part of roll, but when he initiated backstick pressure, autorotation to the right began with only a very slight buffet. After applying spin prevention inputs to the controls, the IP was able to regain control and recover the aircraft. When this autorotation occurred, it became the seventh documented case of autorotation in the T-37 in the past ten years, and was *not* "just another spin"!

Pilots in the T-37 community recognize that spins happen because of stall and yaw and have learned this since becoming fledgling aviators. Normally, four entries are used for spin scenarios in the T-37. There are the low and high right/left combinations, which every pilot going through undergraduate pilot training (UPT) gets to see. This is where the nose of the aircraft is brought up until the aircraft starts to buffet, and you stomp on the rudder to get the spin to begin. Another entry discussed in the T-37 Dash-1 comes from adverse yaw, which causes the aircraft to roll in the direction opposite the yaw and results in a spin. Finally, there is the gyroscopic effect of the engines, which could induce a spin to the left without the use of rudders.

Looking at the breakout mentioned earlier, the roll went to the right and the aircraft spun to the right. The rudder remained fixed at neutral. Adverse yaw? No! The aircraft did not reverse the roll to the left and enter a left spin. It went right! Why? I initially thought this happened due to a phenomenon known as *inertial coupling.*

Most pilots hear this term for the first time in UPT during T-38 academics. However, it happens in the A-37 (a T-37 derivative) also. Simply defined, inertial coupling occurs anytime you have acceleration rates about two axes generating an acceleration about a third axis. For this example: Roll Rate + Pitch Rate = Yaw Acceleration Generating a Departure = Spin! Keep in mind that inertial effects got you to this point, and they can affect the overall spin characteristics of the aircraft. The higher the energy level (airspeed) of the aircraft, the greater the angular rates will be. The higher angular rates can combine with the inertial characteristics and give you a very different looking spin.

Knowing the similarities between the A-37 and the T-37 begged the question: Could the T-37 inertially depart controlled flight under the conditions of the breakout described above?

In April 2001, HQ AETC/DOF and 19 AF/DO sponsored a flight test program called HAVE SPIN. The United States Air Force Test Pilot School (USAFTPS) had responsibility as the test organization for the program as part of their Test Management Project curriculum requirement. TPS spent $43,000 of TPS resources, with AETC donating the IPs, the aircraft and the flying hours. The program consisted of ten test missions for 14.2 hours and 178 departure-and-spin data points in speeds ranging from 100-150 KIAS. The good news is, under the conditions tested with rudder fixed at neutral, aerodynamic effects governed the departures and not inertial effects.

The team noticed two types of departures. The first, mentioned above, dealt with adverse yaw. Adverse yaw happened in all cases *when full aileron was held* in the direction of the roll.

The team called the second a "rolling departure." Pilot comments described the departure as an aerodynamic stall followed by a roll and yaw in the same direction of the initial input. Similar characteristics were observed throughout the tested airspeed envelope. After 90-135 degrees of roll and full aft stick input, the aircraft would pass through approximately a second of heavy buffet, then "hesitate" in bank and yaw for approximately one to two seconds. The nose would then drop, with increasing yaw in the same direction. Full aft stick was held throughout the maneuvers and any forward stick movement to break the stall worked in every case. The departure was easily induced to the left but not to the right.

The test team came up with two recommendations:

1. AETC should add academic instruction for instructor pilots and students on both the rolling and adverse yaw departure modes and how to avoid these departures.

2. AETC should add a full lateral/full aft stick spin demonstration to the T-37 instructor pilot familiarization sortie to demonstrate both the rolling and adverse yaw spin entry without rudder deflection.

A review of the past ten years of inadvertent spins in the T-37 reveals that the nose-high recovery is another maneuver conducive to spins. Out of 241 documented inadvertent spins over the past ten years, 85 came during nose-high recoveries. How many of you teach the students to just roll and pull, or roll, plant the wings and then pull? To prevent an inadvertent spin, try teaching the students to roll, plant the lift vector and then pull. *The bottom line is, if you are rolling when you stall the aircraft, you will very likely enter a spin.* You do not need to be afraid of breakouts; just keep in the back of your mind the possibilities and the recovery options.

This article is aimed at raising pilot awareness of situations where inadvertent spins and autorotation are more pronounced. Let's go to school on these maneuvers and prevent any future mishaps.

The other thing I hope you take away from this article is the sense that if you see something that doesn't look right, start asking questions. You might be the person who prevents a mishap by breaking the chain of events. Keep this in mind the next time you are maneuvering the aircraft.

I learned about inertial effects as a captain working at the USAFTPS back in 1986. Having that experience allowed me to recognize something *not* right and help identify it. Have fun and fly safe!

Adverse yaw happened in all cases when full aileron was held in the direction of the roll.

HQ AFSC Photo by
TSgt Michael Featherston

"Whaddaya Mean We Gotta Wear White, 100% Cotton Coveralls During LOX Servicing?!?"

MR. JOE VIGIL
HQ AFSC/SEGS
CHIEF MIKE BAKER
HQ AFSC/SEMM

The US Air Force Chief of Safety recently issued an "All Safety Communication" (ALSAFECOM) message, ALSAFECOM 007/01, that addressed apparel *required* to be worn—and *not* worn—during LOX servicing operations. The message generated more than a few questions, so we'd like to answer some of those asked most often. Here's a reprint of the ALSAFECOM message, followed by those Frequently Asked Questions (FAQ) with answers. If you have additional questions concerning the ALSAFECOM message, please direct them to your MAJCOM Safety Functional *first*. They've likely heard the question before and can provide an immediate answer.

The ALSAFECOM Message
USAF Kirtland AFB NM//SE//ALSAFECOM
ANG Washington DC//DOS//INFO HQ AFSC Kirtland AFB NM//SEG//
UNCLAS

Subject: ALSAFECOM 007/01, Personal Protective Equipment (PPE) For Liquid Oxygen (LOX) Servicing

1. This is a retransmission of ALSAFECOM 002/99 originally issued in March 1999. The guidance set forth in the original ALSAFECOM remains in effect. Latest available information regarding this issue is included in paragraphs six and seven.

2. Major hazards associated with the operational use of liquid and gaseous oxygen are fire and explosion. In an oxygen-rich environment, the battle dress uniform (BDU), synthetic fabrics and the chemical warfare defense ensemble (CWDE) may become saturated with oxygen, ignite readily, and burn violently. To date, there is neither an industry standard on the wear of body protection when conducting LOX operations nor a test that can be applied to all materials to produce ignition temperature values. Leaking or spilled liquid oxygen can form potentially dangerous, high concentrations of oxygen gas.

3. The National Aeronautics and Space Administration (NASA) and the Air Force (AF), in a joint partnering effort, met from 16-18 March 1999, and concluded: "To minimize the unknown ignition potential of electro-static discharge (ESD), 100 percent cotton, cuffless, long-sleeved coveralls will be worn as the outer garment when flowing LOX. When an individual may be splashed with liquid, a rubber apron will also be worn." This change will remain in effect until the ESD potential of clothing is tested and confirmed. This message supersedes all Air Force publications for body protection during LOX servicing.

4. Calgon Commercial Division, the manufacturer of the chemical warfare defense ensemble (CWDE), NSN: 8415-01-137-1704, states in their material safety data sheet (MSDS), "Fire And Explosion Hazard Data: Contact with strong oxidizers such as ozone, liquid oxygen, chlorine, permanganate, etc., may result in fire. Reactivity Data: Materials To Avoid: Strong oxidizers such as ozone, liquid oxygen, chlorine, permanganate, etc." The MSDS is available on the World Wide Web at: http://www.hazard.com/msds/h/q202/q150.html

5. Effective immediately, chemical protective suits will not be worn when servicing LOX in an exercise or training environment. The CWDE will be removed prior to start of LOX flow and will not be donned until lines are disconnected. PPE in paragraph three will be worn.

6. Subsequently, since March 1999, the AFSC has also included the chemical warfare mask C-2 filter canister which, for this issue, will be considered as part of the CWDE. Calgon Commercial Division, the manufacturer of the chemical warfare mask C-2 filter, NSN: 4240-01-119-2315, states in their material safety data sheet (MSDS), "Fire And Explosion Hazard Data: Contact with strong oxidizers may result in fire. Reactivity Data: Materials To Avoid: Strong oxidizers such as ozone, liquid oxygen, chlorine, permanganate, etc." The MSDS is available on the World Wide Web at: http://www.hazard.com/ msds/h/q494/q443.html.

7. AFSC will continue to work with AF, DOD, and other agencies in an effort to obtain definitive information regarding potential hazards associated with operational use of LOX and wear of the BDU and chemical protective clothing. In the absence of hard data, unless future tests or expert opinion is rendered, precautions established in ALSAFECOM 002/99 will remain permanently in effect. This guidance is also applicable to the joint service lightweight integrated suit technology (JS-LIST). Unless dictated otherwise, white 100 percent cotton coveralls are the required outer garment for LOX servicing operations. Future AF Occupational Safety and Health (AFOSH) guidance will be changed to reflect this position as the minimum AF standard for LOX servicing operations. This is an AF/IL, AF/SE, and AF/SG coordinated message. POC for this subject is Mr. Vigil, HQ AFSC/SEGS, DSN 246-0826.

continued on next page

Leaking or spilled liquid oxygen can form potentially dangerous, high concentrations of oxygen gas.

Frequently Asked Questions (FAQ) and Answers

QUESTION: This ALSAFECOM message states "…white, 100 percent cotton coveralls are the required outer garment for LOX servicing operations." Why?

ANSWER: Interaction between petroleum-based products—grease, oil, hydraulic fluids, fuels—and LOX can easily result in fire or explosion. Since grease, oil and other petroleum-based product stains will be readily visible on white cotton coveralls, a potential wearer can spot them and avoid using that set of coveralls, eliminating one more potential hazard from the LOX servicing operation. Also, cotton is less likely to ignite and burn than a synthetic fabric. That's why wear of white, 100 percent cotton coveralls is the standard.

Interaction between petroleum-based products and LOX can easily result in fire or explosion.

QUESTION: Our white, cotton coveralls use Velcro™, a synthetic material, for closure, not buttons. Must we replace these coveralls?

ANSWER: No. You need not replace otherwise serviceable white cotton coveralls. The requirement for "100 percent cotton" was not intended to preclude use of coveralls with Velcro™ material for closure.

QUESTION: The message implies in paragraph 2 that the BDU uniform may present an ignition and fire hazard. Does this mean the BDU uniform is unsafe or should be removed before donning the white, 100 percent cotton coveralls for LOX servicing?

ANSWER: Again, the short answer is "No." The message was intended to highlight the fact that synthetic materials found in BDU garments may ignite easily and burn violently *if they become oxygen-saturated and are exposed to an ignition source.* At the risk of sounding obvious, here are a couple of key things to remember. One: LOX servicing is an inherently dangerous operation. Taking every possible precaution to reduce the hazard potential is the only way we should conduct business, but LOX servicing operations will never be risk-free. Two: Wearing required PPE—including the white cotton coveralls—adhering to applicable directives and ensuring you treat every LOX servicing operation with the attentiveness and caution it deserves will substantially reduce the possibility of personal injury.

QUESTION: Our aprons have a synthetic strap instead of a cotton strap. Must we replace the straps or the aprons?

ANSWER: No. Again, the intent for singling out "synthetic fabrics" in the ALSAFECOM message was to alert all involved in LOX servicing operations to the fact that synthetic materials burn more readily. Intent was to minimize, as much as practicable, the presence of "synthetic fabrics" from items of apparel worn during the servicing operation.

QUESTION: Paragraphs 5 and 6 in the message state the chemical warfare defense ensemble (CWDE)—including the chemical warfare mask C-2 filter canister—won't be worn when servicing LOX in the exercise or training environment. Why?

ANSWER: To eliminate as many hazards as possible. The manufacturer's Material Safety Data Sheets (MSDS) for the CWDE and mask filter make the following statements: *"Fire and Explosion Hazard Data:* Contact with strong oxidizers such as ozone, liquid oxygen, chlorine, permanganate, etc., may result in fire. *Reactivity Data:* Materials to avoid: strong oxidizers such as ozone, liquid oxygen, chlorine, permanganate, etc." When a manufacturer's MSDS makes those statements, you *listen* and you *comply*.

QUESTION: AFOSHSTD 91-100, *Aircraft Flight Line—Ground Operations and Activities*, provides PPE guidance for gloves worn during LOX servicing operations. Does this mean we may use *only* those gloves specified in AFOSHSTD 91-100?

ANSWER: No. So long as those gloves meet or exceed the specifications of the gloves specified in AFOSHSTD 91-100, they may be used.

QUESTION: The largest size of white cotton coveralls currently available through the USAF supply system is "XXL." We need larger sizes. What do we do?

ANSWER: You'll need to procure them from an outside source. This will likely involve some research on your part and making an IMPAC purchase, but if that's what it takes to afford your folks maximum protection during LOX servicing operations, it's a small inconvenience. ✈

After The Ejection

Illustration by Dave Baer

MAJOR (CAF) KURT SALADANA
HQ AFSC/SEFF

You're standing on the ground looking at two plumes of black smoke about a mile to the south and asking yourself: "What the hell just happened?"

A few minutes ago you were in the "phone booth" with an F-16. The 1 v 1 dissimilar air combat mission started out as a Beyond Visual Range engagement, but with positive Visual Identification required. Of course, the fight quickly turned into a close-in, turning, knife-fight—tactically a mistake, but a lot of fun to fly. You briefed face-to-face and adhered to all regulations and rules of engagement. Or at least you thought you did. You lost sight when you both went into the vertical and called "Blind!" but heard "Continue" in response. You remember a loud bang just before your aircraft departed controlled flight and started coming apart. You don't actually remember pulling the ejection handles or performing any of the actions required for the parachute landing fall (PLF), but you're standing up, a little shaken but not really feeling any pain. The rote training must have worked as advertised.

You begin to become more alert, sort of like when you were in college and drifted off in class, then suddenly regained focus. The emergency radio is in your hand and you're not sure how it got there, but you begin to transmit, first to the F-16 you were fighting, and then in the blind. There isn't any response—you were the last mission on the schedule, so there probably isn't anyone else on the ranges.

The two smoke plumes and lack of comm with the F-16 lead you to believe it also crashed, so you scan the horizon looking for the other pilot. You don't see anyone, but he could be masked behind terrain, hurt or unconscious. Okay, what do you do now?

continued on next page

“First Steps”

In a combat situation, you would grab your hit-and-run kit and employ escape and evasion training while setting yourself up for combat rescue. But what do you do in peacetime? Some actions are obvious. If you are in imminent danger (for example, the crashed aircraft started a brush fire that is sweeping toward you), do whatever is required to save your skin. If you are standing in driving rain or blowing snow, try to find (or make) shelter. If immediate danger is not a factor, the best plan is to stay where you are, drink some water and spend a little time thinking about your situation and what you really need to do next.

Reviewing ejections that have occurred over the past five years, it is apparent that stopping and thinking is not a common post-PLF action. There are several reasons for this. The first, and probably most significant, is shock. In all likelihood, the person who ejected was flying along fat, dumb and happy, enjoying a perfectly normal flight during a perfectly normal day just before an emergency necessitated ejection. Being thrown suddenly from your aircraft at up to 12 Gs and hitting the ground only minutes or seconds later is, at the least, disorienting. Short-term memory loss is not unusual for the period from just prior to ejection through the PLF. Next, there is a natural tendency for the pilot to waste brain-bytes by second-guessing actions taken leading up to ejection: Did I do everything correctly? Did I miss something? Did I do something wrong?

Another reason for not taking time to properly assess the situation has to do with the type of people who fly ejection seat-equipped aircraft and the training these people receive. A person flying a high performance aircraft is one of only a few selected from a large number. To qualify to get into the cockpit, the person had to demonstrate ability, aptitude and attitude suitable for flying combat missions. Invariably, this means the person is dynamic, at least in the flying-related aspects of his or her life. Because we "train like we fight," our ejection training stresses combat survival more than peacetime risk management. While preserving life and preventing further injury are the bottom line in either case, the considerations are significantly different. On a peacetime training mission you aren’t worried about evading an enemy.

“What Next?”

So, what should you do after your PLF if there is no immediate danger and the weather is tolerable? The answer is simple, and one that student pilots hear on a daily basis—slow down, think about the situation and use common sense. This is an unnatural course of action. Chances are, if you just ejected, your system is pumped full of adrenaline, and your body demands action. Your training reinforces this. Unfortunately, taking unnecessary action is probably the worst option available.

If you just ejected, you probably suffered some form of injury, and you will be experiencing some degree of shock. This shock, and the adrenaline in your system, can easily mask serious injury. You could have damaged your spine or internal organs, but feel no ill effects. If this is the case, moving around unnecessarily is going to expose you to the risk of further injury. In a "worst case scenario" this could mean a hangman’s fracture—a complete fracture of one of the uppermost vertebrae through which passes all of the wiring for your central nervous system—and the chance of suffering permanent spinal damage. To be blunt, moving around unnecessarily after ejecting and before being examined by qualified medical personnel could result in you spending the rest of your life in a wheelchair. A more common ejection-related injury is the fracture of the vertebrae of the lower back. This may not leave you a paraplegic, but it could leave you with a life filled with chronic pain and restricted motion. (Kiss flying a bang-seat aircraft, lifting up your kids or breaking 100 on the links goodbye! And, even if you wanted to, you wouldn’t be able to fly a helicopter.)

Okay, you stop and think—what are your considerations? The first thing to worry about is your survival, both short- and long-term. Getting out of the path of a fire is going to be instinctive, but thinking about the dangers downwind of the crash, such as liberated composite fibers (which you won’t see), may not be quite as obvious. This survival requirement extends to crewmembers, aircrew from other aircraft (in the event of a midair collision) and anyone on the ground. Remember that first aid training you had to take? Now’s the time to put it to use—take care of life-threatening injuries, at least as well as you can. If separated from someone else who ejected with you, but in contact via survival radio, you can determine each other’s condition. Without a radio response, trying to find the other downed aircrew is the next rational step. In the scenario, the Viper driver may be bleeding, have restricted breathing, be incapacitated and in harm’s way, etc. A quick assessment will tell you the possibility of saving someone; the other pilot’s life is worth the risk of spinal damage. If all “ejectees” check in and are in good shape, depending upon how long you’ll have to wait for rescue, there may be no necessity to get to one another.

“Rescue!”

The next consideration is rescue. Your actions are going to depend upon how long it will take before rescue personnel arrive. Sure, in most cases, help will arrive in less than three hours, but it’s not hard to think of circumstances where weather or location is going to delay rescue, perhaps for a day or two. If you are talking to Search and Rescue Combat Air Patrol (SARCAP), you know they are coordinating getting someone to you. If all you hear on your radio is static, you know your ejection tone will have been detected, and that will have started the SAR process. Even if the tone didn't work, you know that your squadron will begin the overdue aircraft drill, and rescuers will be in motion. There is a judgment call here—is it better to stay in one place and await rescue, or is it better to walk to a nearby road and flag down help? Well, you're paid the big bucks to apply your training and experience and make a decision. Hopefully, you have enough information to make it the right one. The bottom line: If you can see the rescuers, they can probably see you; if not, you have signaling devices. If at all possible, wait for rescuers to come to you.

Frequently, rescuers turn out to be witnesses to the crash or emergency response personnel from a local community. If this is the case, it is likely that these people will have no training whatsoever regarding how to examine or treat someone who has just ejected. In most cases, unless injury is obvious, these rescuers will simply ask the survivor how he or she feels. It's not unusual for these rescuers to get the survivor to squeeze into a spare seat or jump into the back of a pickup truck and then drive across rugged terrain to reach another survivor or get back to a road. A survivor with spinal damage isn't improving the chances of avoiding permanent injury by allowing him or herself to be bounced across the countryside.

"Ejection *Isn't* Recreation!"

For some reason, many people equate ejecting to skydiving. *But they aren't the same!* Skydivers spend pre-flight time planning the jump and discussing related items such as freefall, deployment altitudes, parachute malfunctions and emergencies. Military pilots spend their preflight hours planning routes and briefing the operational portion of the mission. They brief an "emergency of the day," but really rely on emergency procedure training to handle anything out of the ordinary. Skydivers get in an aircraft for the sole purpose of jumping out of it. Military aircrew only leave their aircraft as the result of some emergency. They may be prepared to respond to the emergency, and they may have enough time prior to ejecting to carefully think through the required ejection and PLF steps. However, a "nylon let-down" is not their focus for the day—in fact, the excursion from the planned mission is a complete surprise. Skydivers egress an aircraft at one G, level, unaccelerated flight, i.e., they step out. When military aircrew eject, the aircraft could be in virtually any attitude, at any airspeed—climbing, descending, tumbling, oscillating, accelerating or decelerating. The aircrew could be pinned to the canopy when they initiate ejection. Skydivers have parachutes with large canopies that make their landing velocities much slower than the velocities associated with the relatively small parachute canopies used in ejection systems. The odds of being injured or in shock as a result of skydiving are *low*. The odds of being injured or in shock as a result of ejection and the subsequent PLF are *high*.

I've spent a lot of time discussing the possibility of back injury due to ejection, but are there any numbers that substantiate the fear-mongering presented? While spinal cord damage may be rare, spinal compression fractures are not. According to the USAF Flight Surgeon's Guide, Chapter 17, "It is estimated that radiographic evidence of fracture can be found in 30 to 50 percent of aircrew after ejection."
(http://wwwsam.brooks.af.mil/af/files/fsguide/HTML/Chapter_17.html)

Taking it easy after ejecting and letting the rescuers do the job for which they are trained is a way that about 20 individuals per year can personally employ risk management. And this can prevent the USAF from losing the use of a valuable asset—a pilot mentally and physically capable of flying a high performance aircraft.

"Your Checklist"

To summarize, especially for the fighter types who, when reading mishap messages, always skip from the narrative to the findings and recommendations, completely blowing off the analysis sections:

1. After ejecting:

a. You *will* experience some degree of shock!

b. Do what you need to do to protect life and minimize further damage.

c. Slow down, think about what you need to do and *use common sense!*

d. Do what you need to do to survive.

e. Do what you need to do to get rescued.

f. Minimize your movement.

g. Don't play macho fighter-guy! Accept (or *demand*) spinal examination and precautions.

2. Sport parachuting is not the same as a PLF.

3. Getting the gears from your buds for being a wuss is a whole lot better than sitting in a wheelchair watching them fly.

'Nuff said? Eject safe!

(Since writing this article, Major Saladana has returned to Canada. He was one of the Flying Safety magazine's most prolific contributors. Major Saladana's commitment to flight safety is unquestionable and his contributions while a member of the HQ Air Force Safety Center team are too numerous to mention. We wish him nothing but the best in his future assignments. Ed.)

USAF Photo

A-10 Class A Flight Mishap: An AIB Report Synopsis

An end-of-runway Maintainer noted oil/fluid dripping out of the cowling on the No. 2 engine.

CHIEF MIKE BAKER
HQ AFSC/SEMM

Class A Mishap: A mishap resulting in one or more of the following: Total mishap cost of $1,000,000 or more; A fatality or permanent total disability; Destruction of an Air Force aircraft. (AFI 91-204, *Safety Investigations and Reports*, paragraph 3.2.2.1.)

Editor's Note: See the box on page 4 for an explanation of "Investigating Class A Mishaps."

What you're about to read was extracted from the AIB Report of a Class A Mishap, so the information isn't "confidential" and we aren't breaking any promises of safety privilege. We have edited some of the verbiage from the Report to make for an easier read, but haven't altered any of the AIB Report facts. Ed.

Accident Summary

During a winter, early afternoon, local continuation training sortie, the A-10 mishap aircraft (MA) experienced a No. 2 engine oil system malfunction due to failure of an oil pressure indicator line, resulting in pilot shutdown of the No. 2 engine. The mishap pilot (MP) maneuvered to final approach where he configured for a single-engine landing in accordance with (IAW) the Dash-1 checklist. While configured on final approach, the MP experienced unfamiliar flight characteristics and initiated a single-engine go-around. During the single-engine go-around, the MP was unable to control the MA, it departed controlled flight and he successfully ejected. The MA impacted the ground less than a mile from the installation and was destroyed on impact.

The Circumstances

The mission was initially briefed and planned as a double turn (two sorties) two-ship mission, with both missions scheduled to fly to a nearby range. The wingman and the MP discussed sortie requirements, planning and briefing assignments the day prior to the sortie. The MP was the scheduled flight lead and was well prepared for the scheduled missions. Both the MP and wingman attended a mass briefing conducted by the squadron Operations Officer. NOTAMS, weather and active ranges were adequately briefed. The MP then accomplished the flight briefing for two sorties, utilizing the squadron briefing guides required by AFI 11-2A/OA-10V3, *A/OA-10 Operations Procedures*.

Testimony from both pilots indicates the briefing was thorough and complete, covering all required briefing items. After the flight briefing the Ops

Officer notified the MP and wingman that neither of their aircraft would be ready for the first sortie. When one aircraft did become available, the MP was given approval for a single-ship mission to the range with the intention of acquiring ("bootlegging") non-scheduled range time once airborne. The flight was properly scheduled, authorized and released in accordance with AFI 11-401, *Flight Management*.

The MA was parked in the aft section of a hardened aircraft shelter (HAS). Preflight inspection was normal with no problems noted. The aircraft forms reflected maintenance performed earlier that day. However, all references to No. 2 engine maintenance—which would later prove to be relevant to this accident investigation—performed following the MA's last flight one week before had already been transcribed and pulled from the aircraft forms. Engine start and taxi were normal.

The MP parked the aircraft at the end-of-runway (EOR) for "Last Chance" inspection and arming. Upon visual inspection of the aircraft, an EOR Maintainer noted oil/fluid dripping out of the cowling on the No. 2 engine and asked the MP if oil pressure on the No. 2 engine was within limits. The MP acknowledged that it was and asked what the problem was. The EOR Maintainer explained the oil/fluid loss to the MP and began examining the leak for tolerances. The MP offered to make a radio call for Red Ball maintenance, but the EOR Maintainer declined the offer. He subsequently cleared the aircraft for flight. According to testimony, the EOR Maintainer believed the oil/fluid leak was deicing fluid. Post-mishap research revealed that the MA had been parked inside a HAS and had not been deiced the day of the mishap.

Takeoff and departure were uneventful. Approximately 20 minutes after takeoff and at about 30 NM from the home field, the MA's Master Caution light illuminated with an accompanying "R ENG OIL PRESS" (Right Engine Oil Pressure) warning light. Oil pressure for the No. 2 engine was fluctuating between 20 and 40 psi. The MP retarded the affected throttle to a position short of idle, turned for home and radioed he was returning with an aircraft malfunction. At about 17 NM out, the MP informed Approach he was having engine trouble and declared an inflight emergency.

The MP elected to proceed towards the field's VFR entry point to have more time to complete the descent and accomplish checklist items. While en route, he referenced the Oil System Malfunction checklist, noted that No. 2 engine oil pressure had dropped to 5 psi (+/- 3 psi) and shut it down IAW the checklist. The MP informed Tower that he was now single-engine and requested a 360-degree turn at the VFR entry point to make sure he completed checklist items. While holding in a right turn he informed the Supervisor of Flying (SOF) he was cleaning up all checklist items and would fly a single-engine, straight-in approach to a full stop. The SOF acknowledged and asked the MP to let him know if he needed further assistance. The SOF then ran the SOF emergency checklist and notified the agencies/persons listed. According to testimony, the MP did not complete the Single-Engine Landing checklist or contact Squadron Operations. The MP then departed the VFR entry point and set up for the single-engine approach to the runway.

According to testimony, the MP configured the aircraft with landing gear only, per the checklist, at about the same time he intercepted the final approach course, at approximately 3000 feet and nine DME. The MP reported "Gear down" six miles from the runway. With 7800 lbs of fuel remaining, IAW the checklist, he calculated a final approach speed of 158 KIAS minimum and attempted to maintain approximately 163 KIAS on final.

Shortly after beginning the descent, the MP observed activation of the mechanical stick shaker. The mechanical stick shaker operates on data provided by the angle-of-attack (AOA) system to warn the pilot 4-12 knots prior to wing stall with mild agitation of the control stick. The MP testified that he never heard aircraft audible stall warning tones. Stall warning tones are activated by inputs from the aircraft's lift transducer vane on the left wing. The MP relaxed back stick pressure to stop the stick shaker, increased No. 1 engine throttle, then increased back stick pressure to re-establish a proper glide path

continued on next page

While en route, he noted that No. 2 engine oil pressure had dropped to 5 psi and shut it down.

and resumed a final approach airspeed of approximately 163 knots. The MP made no mention of increasing rudder application during these recoveries.

Per MP testimony, this series of stick shaker activation and recoveries occurred at least five times on final, resulting in a stair-stepped final glide path. The MP testified he didn't use the turn needle/ball for yaw alignment and was unsure of turn coordination, but used some rudder into the good engine while established on final. During testimony, the MP made no reference or indication that he was attempting to maintain coordinated flight utilizing the turn coordinator, Total Velocity Vector, or outside references. The A-10 Dash-1, T.O. 1A-10A-1-2, *A-10 Flight Manual,* warns that all flight control inputs should be made with constant pilot attention to turn coordination and maintaining airspeed. The Warthog's single-engine flight characteristics differ from dual-engine flight characteristics in three areas:

- The resultant asymmetric thrust requires application of rudder to maintain coordinated flight;
- Loss of one hydraulic system reduces rudder authority. In addition, required rudder forces are significantly higher following failure of the No. 2 engine—as much as an additional 100 lbs. of force may be required; and
- Yaw SAS (stability augmentation) will disengage resulting in the loss of automatic turn coordination and yaw dampening. Fifty percent of this capability is regained when the operative yaw SAS channel is re-engaged.

The aircraft manual states that aircraft sideslip will cause erroneous AOA indications and the stick shaker will not provide accurate warning of an impending stall. According to MP testimony, he was "working hard" to maintain aircraft control on final due to frequent stick shaker activation. The A-10 Dash-1 also states rudder effectiveness decreases as AOA increases. It further explains that failure to apply sufficient and timely rudder inputs may result in yaw rates so high that there is insufficient rudder available for correction and the aircraft will depart controlled flight. Approximately one mile from touchdown the MP testified that the unfamiliar stick shaker activation, combined with the lower than desired altitude, created an unsafe condition, and he made the decision to go around. The MP notified Tower that he was going around and initiated a single-engine go-around by advancing the No. 1 engine throttle, adding back-stick pressure, retracting the gear and adding left rudder.

Failure to apply sufficient and timely rudder inputs may result in yaw rates so high that there is insufficient rudder available for correction.

A post-mishap review of the Tower's audio tapes revealed the SOF noted the aircraft departing controlled flight immediately after the MP's go-around call, and a good parachute within seven seconds of the go-around call. According to MP testimony, the nose of the aircraft continued to track to the right with a mushy feel to the controls. Sensing a lower than normal altitude, continuing right yaw and the MA starting to roll to the right, the MP initiated ejection less than one mile from the runway. The ACES II ejection system functioned successfully in Mode One range (low altitude/low airspeed) and the MP landed with minor injuries.

The MA impacted relatively flat terrain, approximately 30 degrees nose down, inverted, with the right wing down approximately 40 degrees. Most of the wreckage was thrown forward, broke up and was scattered over a wedge-shaped area measuring 100 feet by 150 feet.

Maintenance

Forms Documentation. The MA's Air Force Technical Order (AFTO) Forms 781 were reviewed. Most, but not all, forms entries were documented correctly. Historical records showed no recurring maintenance problems, but did reveal work had been done on the No. 2 engine oil pressure transmitter system seven days prior to the mishap. The mishap was the first flight after replacement of the No. 2 engine oil pressure transmitter line.

Inspections. Basic Postflight, Preflight and Thruflight Inspections were accomplished within T.O. specified time limits. Other inspection requirements listed in the AFTO Form 781K were accomplished within prescribed airframe hour or chronological limits.

Maintenance Procedures. Maintenance was performed on the No. 2 engine to replace a broken engine oil pressure transmitter line. This line provides engine oil pressure from the lube and scavenge pump to the oil pressure transmitter. Documentation within the historical AFTO Forms 781 records relating to replacement of the line reflected that the mishap Maintainer (MM) who accomplished the task used an incorrect technical order and improper Red X clearance procedures.

• The technical order used was documented in the aircraft forms as T.O. 1A-10A-2-71JG-4. This T.O. is titled "*APU Accessory, Removal and Installation*." The correct technical order for this task is T.O. 1A-10A-2-71JG-5, *Power Plant Accessory, Removal and Installation*.

• The MM who changed the oil line was task-certified but cleared his own Red X. The person who relieved him on the next shift was not task-certified but signed the "Corrected By" block. Although the MM was certified to clear Red Xs, the act of clearing his own Red X is contrary to requirements spelled out in T.O. 00-20-1, *Aerospace Equipment Maintenance, General Policies and Procedures*.

According to testimony of the individual who came in on the next shift, he motored the engine—letting it rotate without starting—for two minutes to ensure oil was distributed throughout the engine. After motoring, he closed the inner engine shroud and outer cowlings for a ground maintenance run to leak check the oil transmitter line. The operational check performed on the affected engine was not performed IAW follow-on maintenance required by T.O. 1A-10A-2-71JG-2, *Power Plant/APU Operation and Trim*. The T.O. states: "Run engine at Maximum Power Engine Trim (ITT) and ensure that engine oil pressure and other engine indications are within normal operating ranges." Instead, the engine was operated no higher than 80% core speed. The leak and operational check was signed off as completed.

When the MA reached EOR prior to the mishap flight, MP and EOR Maintainer testimony was that fluid was found coming from the No. 2 engine cowling. The EOR Maintainer testified it was a brown liquid substance and he was initially concerned about the possible leak. However, he inappropriately applied leakage limits found in Table 1-2 of T.O. lA-10A-2-71TS-1, *Troubleshooting, Power Plant/APU, USAF A-10A/OA-10A Aircraft*. Table 1-2 indicates an allowable 100 drops per minute from the ganged drain. However, the fluid was dripping from the bottom of the engine cowling, not the ganged drain. The EOR Maintainer improperly assessed the leak and released the aircraft for flight without ascertaining with certainty the airworthiness of the No. 2 engine.

Maintenance Personnel and Supervision.

Training records of the mishap Maintainer who replaced the oil pressure transmitter line, AFSC 2A353J, reflected he was previously trained to perform the task. The individual that inspected the work and signed off the "Corrected By" block, AFSC 2A373J, was not trained on removal/replacement of the oil pressure transmitter. Training records indicated he was qualified to perform the engine run. The EOR Maintainer's training records indicated he was qualified for his duties.

A squadron training program for the 2A3X3J career field is established and has addressed the when, what, who, by whom, where and how for most maintenance tasks required to be accomplished. However, there were other tasks that should have been included but were not, to include "Removal/Replacement—Oil Pressure Transmitter." Additionally, no other AFSC within the squadron has this item identified in their Career Field Education and Training Plan (CFETP). Training plans within the Sortie Generation Flight are not standardized and documentation/administrative errors existed throughout the records reviewed.

Condition of Aircraft Systems

A review of the MA's maintenance records did not indicate any significant maintenance to instrumentation relevant to this mishap. A review of maintenance history on the MA's flight control systems did not reveal significant maintenance of any relevance to this mishap.

A depot engine equipment specialist examined the engines and reached the following conclusions: Both engines sustained compression damage from hitting soft, farmland surface at a sharp angle at low speed. Based on the engine

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The Mishap Maintainer did not clamp the oil pressure transmitter line IAW applicable tech data.

specialist's analysis, the No.1 engine was operating normally at, or near, max power at the time of aircraft impact, while the No. 2 engine was not operating. With the exception of the replacement of the No. 2 engine's oil pressure transmitter line, aircraft records do not indicate any other significant maintenance relevant to this mishap.

The cracked No. 2 engine oil pressure transmitter line from the mishap engine (ME), and the previous line that had been replaced in the ME, were sent to depot for examination. Analysis indicates both lines had failed due to overtension/stress cracks.

Operations

Mishap Pilot (MP) Qualifications.

The MP is an experienced Command Pilot with over 2000 hours in the A/OA-10 and over 3700 flying hours total time. The MP was current and qualified in the A/OA-10 aircraft at the time of the mishap. Recent flight time is as follows:

	Hours	Sorties
30 days	7.5	5
60 days	10.3	7
90 days	22.9	14

The MP was medically qualified at the time of the mishap. MP testimony indicates that all crew rest and crew duty time requirements were met and he felt fine prior to the mishap. All post-mishap tests were acceptable with no signs of injury or fractures. Post-mishap toxicology tests were normal. There is no evidence that unusual habits, behavior or stress on the part of the MP contributed to the accident.

Operations Personnel and Supervision

Operations. Pilot and flying requirements are being effectively managed.

Supervision. The mission was authorized correctly in accordance with AFI 11-401. The squadron Ops Officer served as the Top 3 Supervisor, conducted the squadron mass briefing and was readily available to the Operations Desk throughout the mishap sortie. The MP informed the SOF that all checklists were complete. In fact, according to MP testimony, the Single-Engine Landing checklist was not completed, to include step 10, which directs review of single-engine go-around procedures. Squadron supervision was never utilized by the MP during the mishap sortie.

Human Factors Analysis. The MP experienced a No. 1 engine failure in a sortie approximately one year prior to the mishap and recovered the aircraft uneventfully, utilizing single-engine procedures. MP testimony indicates he felt current and confident about flying a single-engine approach. The aircraft flight manual warns that a No. 2 engine failure requires significantly more rudder to offset yaw than a No. 1 engine failure. Flying training sorties with one engine at idle, and the prior experience of flying a single-engine approach with the No. 1 engine shut down, may have contributed to a negative transfer of the amount of rudder required for a No. 2 engine failure *("Negative transfer" is a form of habit pattern interference. Ed.)* The MP also failed to analyze why the stick shaker was activating on final. Not completing the Single-Engine Landing checklist, coupled with continuing the approach after stick shaker activation could be indications of misprioritization. The desire to land a bad aircraft may have overridden the tasks of completing a checklist and channelized the MP on landing rather than analyzing why the aircraft was not flying as anticipated.

Known or Suspected Deviations from Directives or Publications.

Mishap Pilot. The MP failed to heed aircraft operating manual warnings regarding sideslip and single-engine approaches:

- T.O. 1A-10A-1-2, "Warning." During single-engine approaches, all flight control inputs should be made with constant pilot attention to turn coordination and maintaining approach airspeed. Increased power settings must be led by timely and coordinated rudder inputs.
- T.O. 1A-10A-1-2, "Warning." During single-engine operations, failure to use sufficient rudder, especially during maneuvering turns, can result in large sideslip angles and yaw rates. It is possible to create a condition where the yaw rate becomes so high that there is insufficient rudder available to correct it and the aircraft will depart controlled flight.
- T.O. 1A-10A-1-2, "Warning." Flight tests have shown a significantly higher rudder force is required to maintain

controlled flight following the failure of a No. 2 engine as opposed to the failure of a No. 1 engine. The additional force varies, but has been measured to be as high as 100 pounds. The onset rate is rapid and occurs when the right hydraulic system depressurizes, about the same time that the slats extend. Failure to apply sufficient and timely rudder inputs may result in yaw rates so high that there is insufficient rudder available to correct it, and the aircraft will depart controlled flight.

• T.O. 1A-10A-1-2, "Warning." Increases in AOA result in decreases in rudder effectiveness, decreases in airspeed and increases in sideslip angle. This produces an increase in yawing moment that must be compensated for by increasing rudder into the good engine. If the additional rudder is not applied, the aircraft will rotate to a higher sideslip angle, further decreasing the airspeed. The problem is compounded by the fact that to maintain airspeed, thrust on the good engine must be increased, further increasing the sideslip angle. The pilot should therefore closely monitor airspeed and aircraft attitude, and maintain rudder opposing the failed engine to reduce the sideslip angle.

• T.O. 1A-10A-1-2, "Warning." During single-engine approaches…under-correcting with rudder can lead to aircraft roll-off, requiring excess altitude to recover. All flight control inputs should be made with constant pilot attention to turn coordination and maintaining approach airspeed.

Mishap Maintainer. The MM did not clamp the oil pressure transmitter line IAW applicable tech data.

• The Maintainer who performed the oil pressure transmitter line change was qualified, per his training records. However, he failed to follow applicable clamping procedures and didn't use the required torque wrench and torque setting, as prescribed by T.O. 1A-10A-2-71JG-5. Additionally, though the individual was certified to clear Red Xs, the act of clearing his own Red X is contrary to requirements spelled out in T.O. 00-20-1.

Maintenance Procedures.

Maintenance procedures prescribed in applicable tech data for a ground maintenance engine run and operational checks following an oil pressure transmitter line change were not followed.

• The No. 2 engine operational check was not performed IAW follow-on maintenance in T.O. 1A-10A-2-71JG-2. Tech data states: "Run engine at Maximum Power Engine Trim (ITT) and ensure that engine oil pressure and other engine indications are within normal operating ranges." The engine was operated no higher than 80% core speed.

EOR Maintainer.

The EOR Maintainer who found the No. 2 engine fluid leak misapplied allowable leak limits.

• When the aircraft arrived at EOR for last chance look on the day of the mishap, the EOR Maintainer spotted fluid on the No. 2 engine cowling and failed to call for qualified personnel to properly assess the problem. He was initially concerned about the possible leak and referenced leakage limits found in Table 1-2 of T.O. 1A-10A-2-71TS-1. Table 1-2 indicates an allowable 100 drops per minute from the ganged drain. But the fluid was dripping from the bottom of the engine cowling, not from the ganged drain. The EOR Maintainer improperly assessed this leak and released the aircraft for flight without ascertaining with certainty the airworthiness of the No. 2 engine.

Mishap Cost

The Mishap Aircraft was destroyed. Total cost of this Class A mishap exceeded $10 million.

The EOR Maintainer who found the No. 2 engine fluid leak misapplied allowable leak limits.

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STATEMENT OF OPINION

"Under 10 U.S.C. 2254(d) any opinion of the accident investigators as to the cause of, or the factors contributing to, the accident set forth in the accident investigation report may not be considered as evidence in any civil or criminal proceeding arising from an aircraft accident, nor may such information be considered an admission of liability of the United States or by any person referred to in those conclusions or statements."

Opinion Summary

A standard of substantial evidence was used in determining the existence of significant contributing factors. There are two main aspects to this mishap:

- The failure of the lube pump to oil pressure transmitter line due to improper maintenance practices, resulting in the No. 2 engine being shut down inflight; and
- The mishap pilot's (MP) failure to maintain aircraft control during the single-engine go-around.

A clear and convincing evidence standard was used in arriving at a determination of cause for this mishap.

Discussion of Opinion

The mishap aircraft (MA) was a single-ship mission. Approximately twenty minutes into the sortie, the MP experienced low oil pressure on the No. 2 engine and subsequently had to shut it down.

The cause of the loss of engine oil pressure was improper maintenance practices when replacing the lube pump to oil pressure transmitter line one week prior to the flight. Inspection of the oil line to wiring harness clamping showed the clamps to be installed in a "butterfly" arrangement rather than the "back-to-back" configuration as depicted in the applicable job guide, lA-10A-2-71JG-5. This improper clamping resulted in an increased distance of approximately three-quarters of an inch between the oil line and the wiring harness. This increased distance placed the wiring harness in a position that allowed contact with the closed inner shroud door, which was evidenced by chafing marks on both the inner shroud and the wiring harness. This contact and chafing placed increased tension on the affected oil pressure transmitter line. The line developed a crack at the point where it entered the oil pressure transmitter resulting in loss of oil and oil pressure.

The Maintainer who performed the No. 2 engine oil pressure transmitter line change was trained and qualified to perform the maintenance task; however, he signed off the "Inspected By" block, and not the "Corrected By" block in the AFTO Forms 781A. The individual that actually inspected the work was not signed off as completing the oil transmitter remove/replace task in his AFTO 623 Training Record. He signed off the "Corrected By" block when, in fact, he did not accomplish the work. Both Maintainers were qualified to sign off Red Xs. The original Maintainer did not use the correct job guide or the required torque wrench and torque setting when installing the oil pressure transmitter line. The leak and operational check performed on the No. 2 engine following the oil line change was not performed IAW applicable tech data. The ground maintenance engine run was accomplished at a reduced power setting from that required in the T.O. Failure to operate the No. 2 engine at the required maximum power setting may have prevented maintenance technicians from discovering the oil pressure transmitter line leak.

Additionally, prior to the MA taking off on the mishap sortie (MS), the End-of-Runway (EOR) Maintainer performing "Last Chance" maintenance checks did not adequately assess a possible No. 2 engine oil/fluid leak. The EOR Maintainer did discover the leak prior to takeoff; however, he failed to ascertain with certainty the cause and severity of the leak. It was undetermined if this oil/fluid leak was in fact caused by the lube pump to oil pressure transmitter line crack. This flight was the MA's first sortie following oil pressure transmitter line replacement on the No. 2 engine. The failure of maintenance technicians to properly follow T.O. guidance was a significant contributing factor to this mishap.

The MP was en route to a nearby range on a continuation training sortie. Approximately 20 minutes into

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the MS, the Master Caution and No. 2 engine oil pressure lights illuminated. The MP reversed course and proceeded to return to base. The No. 2 engine oil pressure gauge was steady state 5 psi, with plus or minus 3 psi, so the MP shut it down IAW the Dash-1 checklist. He proceeded to the VFR entry point to the runway, where he flew a 360-degree right-hand turn in order to ensure adequate time to complete applicable checklists. Shortly thereafter, the MP contacted the Supervisor of Flying (SOF) to inform him that "All checklist items were cleaned up." According to MP testimony, he did complete the Engine Oil System Malfunction Checklist, but only the first portion of the Single-Engine Landing Checklist.

The MP intercepted the inbound course at approximately nine DME and 3000 ft MSL while slowing to below 200 KIAS prior to configuring gear only, IAW Dash-1 procedures. The MP planned to fly the single-engine approach slightly steep with a computed minimum final airspeed of 158 KIAS. The MP reported in with Tower at six miles out with gear down while holding 163 KIAS.

Several times throughout the descent to landing, the MP experienced the aircraft stick shaker. Activation of the stick shaker indicates to the pilot that the aircraft is approaching wing stall and that he should execute recovery by relaxing back stick pressure. The A-10 stick shaker receives inputs via the aircraft's angle-of-attack (AOA) system, which activates 4-12 knots above wing stall and is usually accompanied by audible tones. The lift transducer vane located on the left wing activates the audible tones. The MP testified he did not hear audible tones that would normally be associated with stick shaker activation. The lack of audible tones during stick shaker activation supports the conclusion that the MA was in uncoordinated flight.

With increased right sideslip, the MP had to maintain a higher power setting in order to maintain 163 KIAS. Higher power on the No. 1 engine produces even greater right sideslip and requires a significant amount of left rudder for coordinated flight. Insufficient left rudder combined with a higher power setting produces excessive right sideslip. With increased right sideslip the AOA/stick shaker system becomes less reliable and provides erroneous indications.

The MP relaxed back stick pressure each time the stick shaker activated, which in turn increased his rate of descent, resulting in a stairstep-type approach. Prior to re-applying back stick pressure the MP would add power, but he never mentioned adding rudder to compensate for the increased yaw. The MP did not reference the turn-and-slip indicator or any other reference to ascertain amount of yaw present during final approach. Each time the MP released back stick pressure, his descent rate increased until, eventually, he dropped low on the glideslope. Approaching approximately one NM on final, the MA was slightly below the normal glideslope. The proper glideslope for a single-engine approach is to be slightly steep in order to minimize throttle/power inputs and thereby avoid inducing additional yaw. Recovery from the stick shaker by relaxing back stick pressure at the lower altitude would have placed the aircraft well below desired glide path. Post-mishap investigation into other aircraft systems, including the No. 1 engine, hydraulic system integrity, pitot-static system, flight controls, aircraft instrumentation, stability augmentation and AOA systems found no discrepancies.

The MP testified that the unfamiliar stick shaker activation combined with the lower than desired altitude created an unsafe condition and he made the decision to go around. He reported to Tower that he was going around and initiated the maneuver, placing the No. 1 engine throttle to maximum, applying additional left rudder and retracting the landing gear. Shortly after placing the No. 1 engine throttle to maximum, the MA increased its yaw to the right and started to stall. The MP felt his aircraft was out of control and initiated a successful ejection. The Dash-1 goes into great detail about the risks associated with a single-engine go-around and the manner in which this maneuver must be executed. The inherent risks to loss of aircraft control during single-engine go-arounds are high and, in this mishap, the MP's execution proved causal. The MA was destroyed on ground impact.

Pilot error was the cause of this mishap, with maintenance failures as significant contributing factors.

Signed this day:
(DATE)

(AIB PRESIDENT'S NAME), Colonel, USAF
President, Accident Investigation Board

Some Final Comments

We *didn't* publish this to salt the wounds of those involved. We did publish it so that you—the Operator and the Maintainer—can learn from the misfortune of others. Where it occurred is irrelevant, as are the names of those involved. What is relevant is this: You've now been given the "what happened," as determined by an Accident Investigation Board. *Learning* from what happened, and a similar event from taking place in your unit is what this is all about. 'Nuff said.

USAF Class A Flight Mishaps

FY01 Flight Mishaps (Oct 00 - Sep 01)

24 Class A Mishaps
6 Fatalities
21 Aircraft Destroyed

FY00 Flight Mishaps (Oct 99 - Sep 00)

21 Class A Mishaps
7 Fatalities
14 Aircraft Destroyed

04 Oct ♣✶ An RQ-1 Predator UAV crashed while on a routine test mission.

12 Oct ♣ An F-16C crashed during a routine training mission.

23 Oct ♣✶ An RQ-1 Predator UAV went into an uncommanded descent.

13 Nov ♣♣ Two F-16CJs were involved in a midair collision. Only one pilot survived.

16 Nov ♣ An F-16CG on a routine training mission was involved in a midair collision.

06 Dec ♣ A T-38A impacted the ground while on a training mission.

14 Dec ♣ An F-16C crashed shortly after departure.

12 Jan ♣ An A-10A crashed short of the runway.

02 Feb (Added) ✶ A B-1B sustained Class A Mishap-reportable engine fire damage during ground operations.

09 Mar ✶ During a ground maintenance run a KC-135E's No. 2 engine suffered catastrophic damage.

12 Mar ✶ A USAF NCO died during a range training mishap.

21 Mar An F-16B experienced a bird strike but recovered safely. A fire developed after landing. The aircraft suffered structural and engine damage.

21 Mar ♣ An F-16C experienced engine problems soon after takeoff and crashed.

26 Mar ♣♣ Two F-15Cs crashed during a routine training mission. The pilots did not survive.

03 Apr ♣ An F-16CJ crashed while on a routine training mission.

04 Apr An F-15E on a routine training mission recovered safely after sustaining a bird strike.

07 Jun A KC-10A sustained Class A Mishap-reportable engine damage.

12 Jun ♣ An F-16CG crashed during a routine training mission. The pilot was fatally injured.

21 Jun A C-130H sustained Class A Mishap-reportable damage during landing.

06 Jul	♣	An F-16CJ crashed while on a routine training mission. The pilot was fatally injured.
17 Jul	♣	An F-16B flying a chase mission crashed. The two crewmembers suffered fatal injuries.
18 Jul	♣	An F-16CG crashed while on a routine patrol mission.
23 Jul	♣	An F-16DG crashed while on a routine training mission.
26 Jul	♣	An F-16C crashed while on a routine training mission.
13 Aug		An F-16C sustained Class A Mishap-reportable damage during landing. (Revised repair costs resulted in this being downgraded to Class B Mishap status.)
16 Aug		A C-5A sustained Class A Mishap-reportable damage during takeoff.
24 Aug	♣♣	Two T-38s crashed following a midair collision. One pilot was fatally injured.
04 Sep	♣	An A-10A crashed while on a crosscountry flight.
05 Sep	♣	A T-37 on a routine training mission crashed 30 minutes after takeoff.
05 Sep		A C-130E sustained Class A Mishap-reportable engine damage.
25 Sep		A C-5A sustained Class A Mishap-reportable engine damage during takeoff.
26 Sep		A C-17A sustained Class A Mishap-reportable engine damage during flight.

- A Class A mishap is defined as one where there is loss of life, injury resulting in permanent total disability, destruction of an AF aircraft, and/or property damage/loss exceeding $1 million.
- These Class A mishap descriptions have been sanitized to protect privilege.
- Unless otherwise stated, all crewmembers successfully ejected/egressed from their aircraft.
- Reflects only USAF military fatalities.
- ”♣” denotes a destroyed aircraft.
- “✶” denotes a Class A mishap that is of the “non-rate producer” variety. Per AFI 91-204 criteria, only those mishaps categorized as “Flight Mishaps” are used in determining overall Flight Mishap Rates. Non-rate producers include the Class A “Flight-Related,” “Flight-Unmanned Vehicle,” and “Ground” mishaps that are shown here for information purposes.
- Flight and ground safety statistics are updated frequently and may be viewed at the following web address: http://safety.kirtland.af.mil/AFSC/RDBMS/Flight/stats/statspage.html
- **Current as of 02 Oct 01.**

The Aviation Well Done Award is presented for outstanding airmanship and professional performance during a hazardous situation and for a significant contribution to the United States Air Force Mishap Prevention Program.

Colonel Timothy Miner, AFRC
Reserve Assistant to the Director of Weather, AF/XOW

Col Timothy H. Miner, the Reserve Assistant to the Director of Weather (AF/XOW), has been awarded the Air Force Aviation Safety Well Done Award for a web-based course on thunderstorms and their impact on flying. Because his innovation impacts both the aviation and the ground arenas, AFSC has initiated the Ground/Weapons Safety Well Done Award, and Col. Miner has been named its first recipient. In part, the citation reads the "exceptional combination of accurate (and) relevant technical content and innovative presentation make this course a superb tool to improve thunderstorm awareness, thereby reducing potentially serious weather impacts on personnel and resources."

U.S. GOVERNMENT PRINTING OFFICE 2001-673-404/53018

The course, a comprehensive six-lesson internet training tool, is designed for aviators, air traffic controllers and weather personnel. The project is a cooperative effort of AF/XOW and the sponsor, the National Weather Association, a non-profit professional association. Other partners included the Air Force Flight Standards Agency (AFFSA), the Air Force Safety Center (AFSC), the USAF Academy Department of Geography, the Air Force Institute of Technology (AFIT) Department of Physics and Atmospheric Physics, the Allied Pilots Association, the National Oceanic and Atmospheric Administration's Aviation Operations Center, the National Weather Service's Aviation Weather Center, and the Federal Aviation administration, in addition to some university flying programs. Numerous civilian and government agencies provided lesson material.

In accepting the award, Col Miner said, "This was a total force effort of the Air Force Reserves working together with the active duty community to reach out to aviators and operations personnel all over the world. It represents the teamwork that must be a daily part of aviation safety."

The final lesson went online on 18 May 2001, and as of 1 August 2001, over 2500 students have "officially" enrolled in the course from 19 countries on six continents. Military students include all five US service branches, as well as all reserve components and the USAF Auxiliary Civil Air Patrol. Military pilots range from UPT students at Vance AFB to two operations group commanders from Air Mobility Command, two MAJCOM Chiefs of Safety, AF pilots deployed overseas in the current AEF, Army helicopter pilots in Europe and Navy P-3 crewmembers stationed in Japan. Other active duty US military enrollees include air traffic controllers and weather personnel. Commercial pilots, airline pilots, civilian instructors and foreign weather personnel have also enrolled. Many "unofficial" enrollees are also using the Web site as a resource—there have been over 250,000 hits on the site since it began on 1 April 2001.

The course is proving a model program. AETC is evaluating the material for future use. FAA's National Director of Safety Programs will recommend it as a role model for future flight safety training. The Federal Coordinator for Meteorological Services and Supporting Research (DoC) is also looking at this as a model program.

Based on the success of this program, Col. Miner has begun planning a Fall 2001 course on winter flying using the same format. By the time you read this, the winter course should have replaced the thunderstorm course on the Web. Check it out at www.nwas.org.

The Ground/Weapons Safety Well Done Award recognizes non-safety personnel who make a significant contribution that affects overall mishap prevention activities toward ground/weapons safety.

Illustration by Dan Harman