

## Aviation Mishap Investigation

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**Aviation in itself is not  
inherently dangerous.**

**But to an even greater degree than the sea, it is terribly  
unforgiving of any carelessness, incapacity or neglect.**

Author Unknown

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Introduction page

## Fort Myer, Virginia

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17 September 2008

- Orville Wright arrives to demonstrate the newest model airplane
- Cash incentive of \$1.00 per every mile per hour over a baseline of 35 MPH
- Wilbur and Orville made the propeller extra long for additional thrust for additional speed
- West Point grad, Lt Thomas Selfridge, sweet talks his way into a getting a ride
- Orville is 70 feet AGL and in a slow, gentle turn above Ft Myer...



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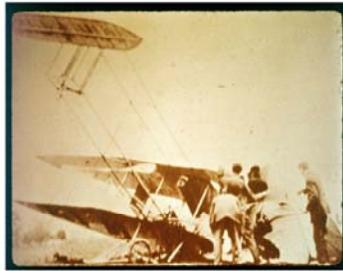
Point out Selfridge strapped into Wright Flyer on bottom picture while Orville performs his pre-flight check

Up to this time, Selfridge had considerable flights in tethered and non-tethered balloons as well as gliders. He was pioneering a “new” Army career field called “Observer” with the purpose being to reconnoiter enemy positions and movements in real-time.

Fort Myer in the 21<sup>st</sup> Century has many more buildings and many more grave sites than the wide open fields pre-dating WWI. Arlington Cemetery (the reason for Ft Myer’s existence) was populated with Civil War and Spanish American War veterans, along with some veterans of Cavalry campaigns. World War I ushered a new era of cemetery management and utilization.

## First Ever Airplane Crash Produces Injury and Fatality

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Aftermath:

Prop tip spinning so fast that 2 inches broke away from one blade. The shrapnel sliced a guy wire, which allowed an elevator to rotate

Orville received several cracked ribs and a broken femur

Selfridge received a traumatic head injury and died during the night. Current thinking is that if he had been wearing a helmet (not invented for another 20 years) his head injury would have been much less severe

Epilogue: Ever since this first mishap, non-pilot crew members – especially navigators – have been highly suspicious of pilots! ☺

## Almost 60 Years Later a C-141B Starlifter Diverts (12 Jan 1987)

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- Iwakuni, Japan
  - 600 Miles SW of Tokyo
  - 120,000 Population
  - Hanshu Island (oceanic tip)
  - Airfield originally built in 1938 for Japanese Navy flight training
- U.S. Marine Corps Air Station (following operation by RAAF)
- Night IMC prevailed
  - Rain
  - Wind
- Fast approach speed and touchdown
  - Hydroplaning

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The C-141 had to divert from the intended landing field at Yakota Air Base because of weather – night, low visibility, rain and fog

Iwakuni presented “best” option out of a list of non-optimal landing choices

Pilot pushed forward on yoke to “stick” airplane on the runway. However, this action lifted the main gear off runway and enhanced the hydroplaning.

Without the main gear on the runway, the thrust reversers could not deploy and the anti-lock brakes would not function

## Hydroplaning Conditions, Context and History

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- Post Korea conflict research develops 2 fix categories for hydroplaning
  - Runway and airfield development
    - Grooves in pavement
    - Crowning
    - Perimeter drainage augmentation
  - Tire pressurization
    - Mathematical formula: Hydroplane Speed =  $9\sqrt{\text{Tire Pressure}}$
    - Tires designed to have higher pressures for approach speeds
      - 121 psi to 144 psi
      - Elevates hydroplaning speed to
        - »  $9\sqrt{121} = 9*11 = 99$  knots
        - »  $9\sqrt{144} = 9*12 = 108$  knots
        - » Speeds in tune with most planned touchdown speeds
    - Aircrew training “forgot” these valuable hydroplaning lessons

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Runway builders have done a lot through the years to make runways usable under a variety of environmental conditions all through the year and through all weather and environmental anomalies

Tire pressurization is a function of supporting aircraft weight, absorbing and cushioning the impact of landing, factoring into ground roll (to include braking), accounting for friction, and a number of other matters, to include hydroplaning.

The Iwakuni mishap demonstrates that the best of tire pressure engineering – and airfield infrastructure support – means nothing if pilots are not taught these valuable factoids and their relevance to aircraft ground operations.

## Hydroplaning Lessons for Personal Vehicles Originating from Aeronautical Science

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- Just as seat belts originated with open cockpit airplanes and migrated to automobiles and trucks, so can hydroplaning critical entry speeds
  - Lets apply the formula: Hydroplaning Speed =  $9\sqrt{\text{Tire Pressure}}$  to various tire pressures found in personal vehicles
    - 25 psi – 45 mph
    - 28 – 47.6
    - 30 – 49.3
    - 32 – 50.9
    - 34 – 52.5
    - 36 – 54
  - Take proactive steps to make tires have correct maximum pressure and slow down to below calculated hydroplane speed for safe vehicle operations on wet roadways

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Know your maximum tire inflation and its hydroplane speed. Then, when on wet pavement, slow to some speed below hydroplaning speed!

## General Hap Arnold Implements a Proactive Approach to Understanding and Mitigating Aviation Mishaps

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- Establishes the “Flight Safety Directorate for Investigations and Trend Analysis” to examine every aircraft mishap
- Points out that more aircraft were destroyed in 1942 training and transport than in all the air war of the same time period in both the European and Pacific Theaters!
- Causes:
  - 85% Logistics
  - 15% Aircrew
- Establishes the precedent of data-driven decision-making that originates with observations, measurable data collection and analysis
- Leverages his considerable liaisons with industry for expert help and partnership from the airplane design stage through its operation and maintenance support



H.H. Arnold got the nickname of “Hap” because of his proclivity to smile

Hap, as a lieutenant, set the world altitude record for flight by going up to 6,000 feet! Today, this altitude is common for student pilots to attain and use on their cross-country training.

Hap Arnold personally worked with airplane manufacturers to develop a synergistic partnership of quality AND technological advancement. His greatest achievement in this regard is the P-51 Mustang and taking it from “unacceptable” to one of the greatest fighters ever put into production.

During WW2, Hap experienced 3 heart attacks, refused a medical discharge, and kept going forward. His attitude was “As long as my boys are fighting an air war, the least I can do is give them all the office support they need to do their job”. (This is one of the reasons that air crews admired, liked and respected General Arnold... they knew he was looking out for them).

Upon retirement, Hap and his family settled in the agrarian Sonoma County, California and 2 weeks later, he passed away in his sleep.

## General Arnold's Forensic Anatomy of a Mishap



...and how its common sense aligns with DMAIC & Lean

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Through sheer luck and fortune, many things were done precisely right on the Wright Flyer mishap analysis, to include photographs. Hap merely “codified” these procedures and refined them.

From a quality and safety perspective, mishap investigation procedures and Lean Six Sigma align very closely.

As you will see later in this presentation, the Air Force has a mere 30 days from time of mishap to have it “wrapped-up”

## U.S. Air Force Mishap Classifications

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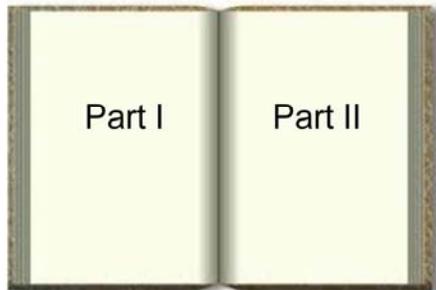
- **Class A:** Total destruction of an aircraft, damage of \$1 million or more, or a fatality or permanent total disability.
- **Class B:** Total cost of \$200,000 or more but less than \$1 million, or a permanent partial disability, or inpatient hospitalization of three or more personnel.
- **Class C:** Total cost of \$10,000 or more but less than \$200,000, or an injury or occupational illness resulting in a loss of 8 hours or more.
- **High Accident Potential (HAP):** Events where there is a potential significant hazard to the crew or aircraft if a similar event were to occur.

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Res ipsa loquitur – the thing speaks for itself

## The Actual Mishap Report – Mechanics

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- Part I
  - Releasable
  - Material facts
    - Define
    - Measure
- Part II
  - Non-Releasable
    - Secures cooperation from manufacturers
  - Interpretations
    - Analyze
    - Improve
    - Control

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Res ipsa loquitur

## Safety Investigation Board (SIB)

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- Purpose
  - Determine cause or causes
  - Provide basis for corrective actions
    - No disciplinary or punitive actions
  - Eliminate mishap potential and prevent future mishaps
- All testimony before SIB has immunity
  - Want assistance in eliciting all facts

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Talking with the Safety Officer / Investigator is like talking to the Chaplain

## SIB Primary Members

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- President
  - Rated Colonel or General
  - Appointed by MAJCOM
  - Not from mishap unit
- Pilot Member
  - Current & qualified in mishap aircraft
  - Wide experience
- Maintenance Member
  - Fully qualified with 2 years experience
- Investigator
  - Rated officer with 4 years flying experience
  - Graduate of Flight Safety Officer course
  - Appointed by MAJCOM
- Recorder
  - Non-voting member
  - All administrative affairs and coordination

## SIB Additional Members

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- Flight Surgeon
- Public Affairs Officer
- Air Traffic Control Officer
- Weather Officer
- Weapons Officer
- Additional Crew Members
- Tech Reps from depot <sup>and/or</sup> industry
- Pathologists
- Federal Agencies
  - FAA
  - FBI
  - NASA
  - NTSB
  - USAF Office of Special Investigations (OSI)

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Specializations are brought in on an as needed basis

Public Affairs handles the media inquiries. Safety/Investigator needs to stay out of limelight to get the job done.

In the F-16 loss of flight information mishap from computer and electronic failure (Harduval incident), the Flight Surgeon gave his copy of the mishap report to the widow and her attorney. He showed up dead within 6 months of the grieving widow winning a lawsuit against General Dynamics. The HBO movie "Afterburn" is about this mishap (Laura Dern, Robert Loggia). In a nutshell: the F-16 has 2 inertial guidance systems and a 3<sup>rd</sup> backup system (conventional pitot static). The mishap pilot used the two "failing" inertial systems, and did not use the standby system. As an aside, the standby system gauges are smaller than a silver dollar.

## SIB Guidelines

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- 30 Days start-to-finish
- SIB Report protected by “Executive Privilege”
- Accident Investigation Board (AIB) is separate investigation
  - Legal investigation (Judge Advocate)
  - Convened by Wing Commander up to MAJCOM Commander
  - Concurrent with SIB
  - Shows “credibility” to taxpayer and is fully releasable
  - The “Hammer” to military <sup>and/or</sup> civilian members
  - Receives “Part I” of SIB report and “Witness list”
- USAF deliberately segregates the two boards and limits their interactions
  - Major General exercised the “early” retirement option as a result of selectively using SIB information to make punitive examples of aircrew members involved in incidents

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If Freedom of Information Act (FOIA) challenges are made on any mishap report, the Air Force claims “Executive Privilege”. At this point, Air Force attorneys contact and bring in their counterparts at the Department of Justice to “defend” the government’s executive privilege over these internal working documents.

The NTSB will take 18-24 months for their investigations, and most are done in an open forum.

As an aside, the NTSB works for Congress, but use FAA facilities. The President nominates key board members and the Senate provides an up-or-down vote on the nominee. After that, NTSB investigations are totally autonomous. The NTSB staff of experts presents their analysis to the NTSB key members, who then discuss, vote and publish it.

If desired, the NTSB can take precedence on any aviation incident – civil or military. Generally, the NTSB stays away from military incidents, to include former Secretary of Commerce Secretary, Ron Brown, discussed later.

## Investigation Synopsis

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- Impound and Close All Records
  - Aircraft maintenance
  - Aircrew
  - Air traffic
  - Medical
  - Weather
- Crash Site Actions
  - Photographs
  - Diagram wreckage
  - Identify parts
  - Gather statements
- Flight Profile Determination
  - Aircrew
  - Witnesses
  - Flight plan
  - Pre-flight activities
  - Wreckage pattern

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Common sense actions. You don't want people "dotting I's and crossing T's" after the fact.

## Heart of the Investigation

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- Gather and interpret evidence
  - Determine sequence of events
  - Use data collected to determine mishap causes
  - Draw upon all information sources
    - Aircraft design through maintenance
    - Human capital training through operational execution
    - Management and supervision
    - Environment of the mission
  - Validate findings
  - Publish
  - Report is coordinated and staffed up through the MAJCOM
    - Many edits from Wing, Air Division and Numbered Air Force
  - Report goes to the Flight Safety Center
    - Safety Center reviews and often goes back to original Flight Safety Officer report
    - Flight Safety Center has the ultimate “final word”

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A lot of “posturing” and “editing” occurs as the report wends its way to the Flight Safety Center, and arm of the Inspector General of the Air Force.

The Flight Safety Center goes back to the Safety Officer’s (Investigator) original notes and reports and uses them to craft its cover document.

Because the Air Force IG “owns” the report – findings, causes, analysis – and is a direct report to the Chief of Staff, with lateral to Secretary of the Air Force, no MAJCOM Commander is going to “rattle the cage” once the report has gone from his desk to the Flight Safety Center and IG.

## Mishap Cause Factors

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- Human – aircrew, maintenance, support
- Supervisory – instructors, “boss”, procedures, directives, manuals
- Logistics – acquisition, material, maintenance
- Environmental – weather, temperature, light, flora and fauna
- Support – infrastructure (meals, sleeping, lounge); services
- Undetermined – often never identified

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Build-up slide

## High Accident Potential (HAP) Criteria

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1. Loss of thrust
2. Engine case penetration
3. Engine case rupture, burn through, fire, massive fuel leak
4. Emergency landing of single-engine aircraft
5. Unselected propeller / thrust reversal
6. Flight control malfunction (Attitude, Heading, Altitude)
7. Spillage or Leakage
8. In-flight pitot-static or gyroscopic instrument loss
9. Runway departure
10. All in-flight fires
11. Any other FSO option event (example will be discussed later)

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#11 is about a landmark T-43 gyro failure and amount of additional time spent investigating its root cause.

This is because with the AHRS being in every single USAF airplane, it was too risky to not completely and thoroughly investigate it to the max.

## Determine Flight Profile

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- Aircrew
- Witness statements
- Mission flight plan
- Aircrew pre-flight briefing record
- Wreckage pattern

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Easiest to hardest methodologies

## Crash Site Actions

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- Photographs
- Diagram wreckage
- Identify parts
- Gather statements

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Photographs: get natural daylight photos from a professional photographer who is on the government payroll

## Brigadier General Robin Olds Establishes the Flight Safety Center (1971) with a Focus on Data-Driven Analysis and Enhances Arnold's Original Vision



- America's 1<sup>st</sup> and only "Triple Ace"
- Grew up around Billy Mitchell, Hap Arnold, Carl Spaatz, and other early air power advocates
- All-American as football "Tackle"
- Charismatic maverick
- Set in motion the "Thunderbirds" ground work
- "There are pilots and there are pilots; with the good ones, it is inborn. You can't teach it. If you are a fighter pilot, you have to be willing to take risks."
- Transformed Flight Safety from "bean counting" to being part of making air combat operations more effective
- 14 July 1922 – 14 June 2007

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Robin Olds was so into flying that he offered to give back a star and wear a colonel's eagles just to keep himself in the cockpit and on the flight line.

Tea cup dialogues: Just as General Olds believed in the "inborn" nature of flying, General Chuck Yeager often stated "there is no such thing as a naturally born pilot".

## Flight Safety: Post Robin Olds

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- Flight safety facilitates mission effectiveness by qualitative and quantitative use of resources
- In military aviation, “flight safety is NOT paramount”... contrary to many a mission briefing
  - Mission objectives are primary
  - Safety supports mission objectives by making resources available
- Mishap Causes – Reversed from Arnold’s days:
  - 15% Logistics
  - 85% Aircrew
- John “Forty Second” Boyd built upon General Olds maverick approach
  - Father of “energy maneuvering” for light-weight, high-tech fighters
  - Developed the OODA Loop
    - Observe – Orient – Decide – Act
  - OODA is the foundation for AFSO21
    - Air Force Smart Operations 21<sup>st</sup> Century
    - Lean Six Sigma, CPI and other proactive implementations

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Colonel Boyd found a way to “use” (some people claim “stole”) mainframe computer calculating capability to “crunch” numbers on his energy maneuverability theories. The net result of Boyd’s work manifested in the F-16 Fighting Falcon, YF-17 (Northrop twin-engine fighter that McDonnell-Douglas modified under a “technology license” to become the F/A-18 Hornet), and A-10 Thunderbolt II.

John Boyd got the nickname of “Forty Second Boyd” from his ability to go from an air-to-air position of disadvantage to winning the engagement in 40 seconds or less. Part of his thinking process for this “shifting the advantage” employed the Observe-Orient-Decide-Act (OODA) concept. OODA was the mnemonic device used for teaching fighter pilots how to get the air-to-air advantage.

## Human Factors and CRM Play Key Role in Mishap Analysis & Mishap Prevention

- Frank Dully, Captain, USN (MD – Flight Surgeon) “Father of Human Factors”
- HF fall into 3 broad categories:
  - Aeromedical
    - Aeronautical adaptation (psychological and physical)
    - Illness, disease, injury
    - Physical factors – fatigue, rest, physical activity, mental workload, environmental
    - Aviation physiology – water/land survival, hypobaric exposure, ejection/egress training, G-tolerance, visual illusions, task management, etc
  - Personal / Social
    - Emotional stress – family/marriage, financial, personality, etc.
  - Performance
    - Flight
    - Ground
- Dully’s “Sex and the Naval Aviator” lecture series
  - Air Force politically correct name “Aircrew Compartmentalization”

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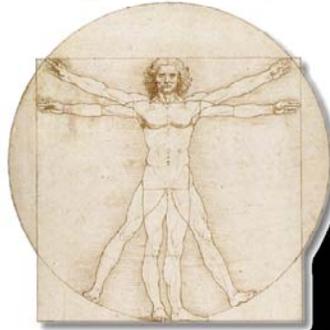
Dr Dully developed a wealth of observations and tools to identify characteristics of the “failing aviator”. These characteristics were relatively easy to identify by flight surgeon and aircrew colleague alike. The end game was to prevent an aviator from strapping into cockpit for which he/she was not fully available to execute the mission with success.

The title, “Sex and the Naval Aviator” resulted from a marketing gimmick to get attention and attendance at his talks. Dully recognized that flying is perceived as a “sexy” business and capitalized upon this perception to make his keen insights on human factors involved in flying safety.

## Representative Mishaps

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- Human factors often work against the Man-Machine interface
  - Consider the 4 mph “man” (with internal systems) and 600 mph “machine” (with internal systems) ... opportunities for disconnects



## T-37 Solo: Stall-Spin Following VMC into IMC

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Student Pilot (SP) departed VMC and entered IMC. All T-37 training was done under VMC and instrument flying got introduced (and mastered) in the T-38 segment of training.

SP was in a MOA (Military Operating Area) for solo practice. A MOA is generally 700 ft Above Ground Level to 14,500 ft AGL (and sometimes up to but not including 18,000 ft MSL).

When SP entered IMC, he became disoriented, improperly handled the flight controls, and entered an unintentional spin. SP was not able to stop the spin and opted to eject.

The flat impact and circular/spiral nature of debris are the wreckage indicators of a spin.

## Vance AFB Auxiliary Airfield Instructor Beer Bet



~ The Unanticipated ~

Bar tab for the ultimate "Beer Bet of Honor"

\$0.35 Officer Club Draft Beer

\$250/Hr T-37 Operating Cost

\$850,000 T-37 Acquisition Cost

- Auxiliary airfields are non-towered and use 2 IPs as Supervisor of Flying (SOF) for solo student pilots practicing touch-and-go landings
- Because the IPs were running early, they challenged each other to precision landings: Land as close as possible to the approach-end of the runway with ONLY one throttle thrust setting
- The approach-end of the concrete runway protruded above the surrounding grass field
- This protruding concrete edge guillotined the Tweet's landing gear
- First student solo arrived and was unable to make radio contact. He returned to main base and reported an airplane collapsed on the runway with a small fire on the right leading edge wing root

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Instructor Pilots (IP) are the backbone of all training, particularly initial student training. As such, any IP is ready to let a SP make a mistake and correct that mistake as part of the learning process.

The purpose of two IPs for Student Pilot training is so that there will "alertness" because 1 IP will rest while the other IP handles SOF duties – "Check gear down and locked; clear for the option".

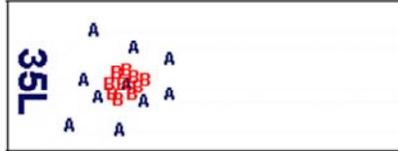
The mishap IPs arranged the following "bet": From the midfield downwind, I can precisely land this airplane at "brick one" with only one (1) throttle setting.

The first IP set his throttle at midfield downwind and did not make any other adjustment, to include when noticing that "short final" was low on altitude. The second IP did nothing to intervene.

The airplane skidded along the runway and effectively closed it until further notice.

## Lesson-Learned Outcome Led to “Consistent, Precision Landings” in Training and Checkrides

**Which Pilot Would You Rather Fly With?**



Main landing gear touchdown point at a predetermined point on the runway is

- Repeatable
- Reproducible
- Scientifically substantiated
- Universally applicable
- Reasonable expectation
- Meets or exceeds Six Sigma accuracy

Airline operations provided baseline to Air Force (and airliners were baselined against US Navy carrier landings)

FAA implemented “precision landings” – accuracy within 200 ft – for private pilot applicants (and above) in 1986 (Six Sigma accuracy)

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Education is an effective means of bringing about change behavior, imparting new knowledge, and reinforcing right behavior.

Education is the least expensive means of implementing “change”, engineering is the most expensive means of implementing change.

## C-141 Weekly Sortie to Pan American Capitals

Huayna Potosi near La Paz, Bolivia



18 August 1974

- Departed Howard AB, Panama for 1,800 NM flight over uninhabited jungle with limited nav aids
- Cleared for enroute descent in IMC, in non-radar environment, from FL240 to FL180 for landing in La Paz (highest elevation airport) with ceilings at 700 AGL
- Impacted Mt Potosi (20,000 ft) at the 18,700 ft level. Crew of 7 fatally injured at impact.
- Waited 3 months for winter to pass before attempting body recovery and mishap investigation
  - Helicopters not capable at these altitudes

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Charleston AFB, SC provided both aircrew and aircraft to make weekly courier runs throughout the Caribbean, Central America, and South America regions.

The aircraft of choice was the C-141 Starlifter, the first all-jet cargo transport airplane. The C-141 serviced both military and State Department needs, with the preponderance of material falling into the category of “diplomatic pouches”.

The air traffic control system south of the United States has historically lagged the US in both radar coverage, ground based navigational aids (presence, accuracy, and maintenance), and voice frequency coverage. The international language of aviation is “English”.

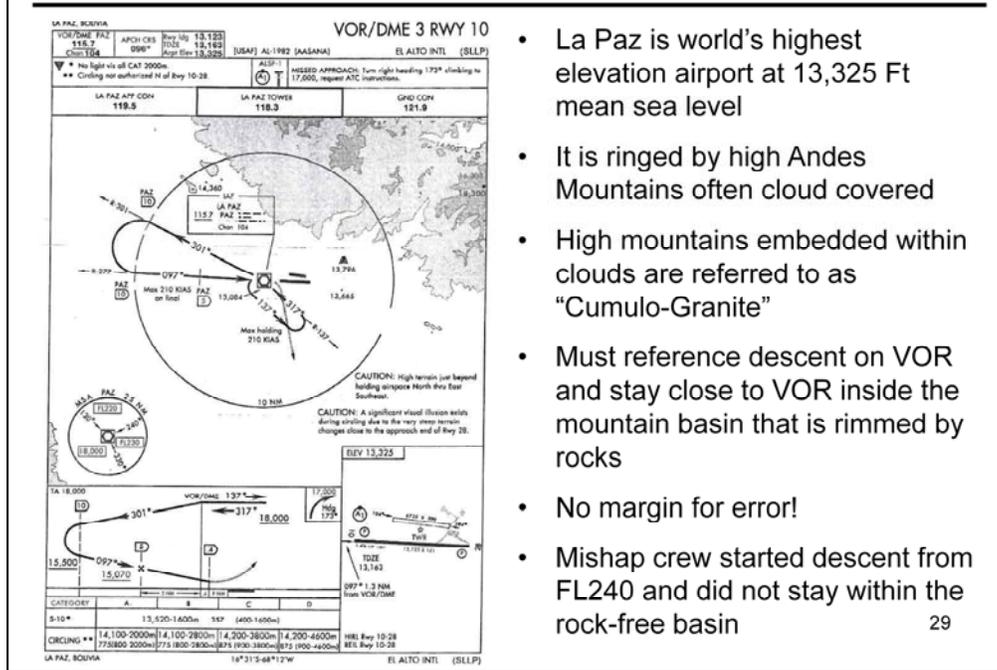
The mishap crew received an ATC instruction: “Cleared from FL240 to FL180, pilot’s discretion; cleared the VOR approach into La Paz”.

The mishap crew was east of the VOR and started their descent at an altitude well above 18,000. As a result, the C-141 was not operating “inside” the protected basin and impacted Mount Potosi.

Given the fact that August is the middle of winter in the southern hemisphere, it took 3 months before any mishap investigation or recovery could occur.

Given the deterioration of human remains, body identification was not possible and all were interred in a mass burial.

## La Paz VOR Approach



- La Paz is world's highest elevation airport at 13,325 Ft mean sea level
- It is ringed by high Andes Mountains often cloud covered
- High mountains embedded within clouds are referred to as "Cumulo-Granite"
- Must reference descent on VOR and stay close to VOR inside the mountain basin that is rimmed by rocks
- No margin for error!
- Mishap crew started descent from FL240 and did not stay within the rock-free basin

Reproduction of Approach plate into La Paz (at the time, the airfield was called John F Kennedy International Airport in memory of America's 35<sup>th</sup> President.

The key to flying this approach is to be at precisely 18,000 feet over the VOR, lose 2,500 ft within 10 NM of that VOR and turn inbound to the FAF being no higher than 15,070 ft before final descent into the runway.

## YB-49: The Original Northrop Flying Wing

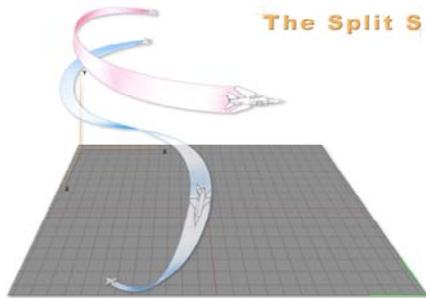


Muroc Field renamed "Edwards AFB"  
Topeka Field (KS) renamed "Forbes Field"

5 June 1948

- Major Dan Forbes and Captain Glenn Edwards are at the controls
- While in a nose high stall, the airplane entered a tail slide, followed by a high-speed tail down spin that led to in-flight structural break-up.
- Engines were not powerful enough to recover the airplane.
  - Underpowered for speed
- Flying wing was viewed as a "slow" medium-range bomber, with limited bomb capacity at best
- Air Force was not interested in its "stealth" qualities until early 1980s
- Jack Northrop "vindicated" when B-2 Stealth Bomber proves his advanced design fully capable 30

## Student Pilot Performs Split-S Maneuver



- Vertical turn-around (reverse direction) maneuver from level flight to lower altitude and opposite direction
- T-38 requires 10,000 ft altitude to execute the maneuver
- Student pilot misread altimeter and was not at 18,800 ft but at 8,800 ft
- Airplane impacted the ground at Mach 0.92 (552 knots) indicated with an ensuing fatality and destroyed airplane

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Middle Eastern SP was practicing maneuvers solo in the MOA.

SP misread altimeter by 10,000 feet

The School of Aerospace Physiology and Aerospace Medicine at Brooks AFB, TX (San Antonio – closed as part of Base Realignment and Closure or BRAC and converted to “Brooks City” in 2002)

Results of their human factors re-engineering are seen in an upcoming slide

## Results of Split-S with Inadequate Altitude

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- Mishap debris relocated to hanger for reconstruction and analysis
- No ejection attempted

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This is the wreckage of the Split-S mishap airplane after it was relocated to a hangar for preservation and analysis

Destroyed airplanes do not look at all like an airplane. Component identification can be difficult.

Sifting through wreckage for clues consumes a lot of time and resources

## Engineering Change Modifications



Original Altimeter



Re-engineered Altimeter  
Applied Human Factors  
Considerations

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Notice how much easier it is to read the “new” altimeter on the right – especially if wearing a flight helmet, oxygen mask, and visors in the “down” position.

In the original altimeter, the arrow with the triangle represents 10,000 ft, the short needle represents thousands of feet, and the short needle represents hundreds of feet.

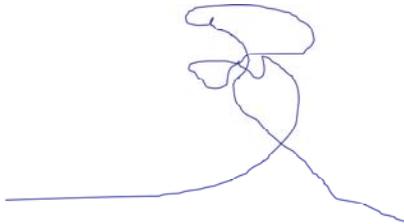
## T-38 Attempted Barrel Roll with Runaway Trim



### Procedures Count!

### Technique Is Important!

- Student Pilot (SP) developed habit of using 2-hands for barrel rolls and loops
- Left hand was on top the 'Aileron-Elevator Trim Button'
- On mishap day, SP activated (unintentionally and unaware) worse case for elevator trim and lost control
- Aircraft destroyed and SP fatal
- FAA 3-dimensional radar plots helped understand aircraft behavior



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Focus attention inside the white circle at the trim control button.

This mishap resulted from a “bad habit” of the SP placing her left hand on top the stick to help with the pull-back for vertical maneuvering.

On the mishap maneuver, the trim button was actuated and the elevator trim when to a full, nose-up position, at which time the SP lost control of the airplane.

The blue line represents the vertical profile in cross-section of the T-38's flight path and comes from radar readouts with altitude encoding.

This was the first female fatality in pilot training. Because the Air Force was under a Congressional mandate to make female pilots become a reality quickly, the Secretary of the Air Force relayed this message to the generals. The generals, in turn, emphasized getting female SP through training without any delays – no washouts, no holding back. Unfortunately and consequently, improper procedures and bad habits were not proactively handled and the remedies used for Caucasian, Black and Asian heritage males were not applied.

## Results of a High-Speed, High-Impact-Angle

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Ground wreckage pattern of a high-speed, high-angle of impact crash

## Flight Path Angle of RF-4C Flying Below the “Hard Deck”

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Crew discovered that surface-to-air pine trees are just as hazardous and dangerous as surface-to-air missiles 36

The RF-4C crew from Shaw AFB, SC – consisting of a Pilot and Weapon System Officer (WSO) – made a conscious crew decision to fly lower than the prescribed low-level route altitude over Georgia.

Both crewmembers had altimeters and radar altimeters available to them. Both crewmembers had full access to flight controls.

The jet engines ingested the tops of conifers and both engines began spooling-down. The crew safely ejected and watch the airplane descend wings level into and through the pine forest.

This photo graphically displays the flight path and aids in mishap reconstruction.

## Bird Strikes Are Serious Matters!

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$$KE = \frac{1}{2} (mV^2)$$

## Although Bird Size Is a Factor, 'Velocity Squared' Is the Significant Component

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KC-135



A-10

38

No airplane type or size is immune from birdstrikes! Combat aircraft will receive as much damage (if not more) as cargo airplanes.

The kinetic energy equation is  $KE = \frac{1}{2} (mv^2)$

The significant factor is the velocity-squared ( $v^2$ )

As will be seen, significant damage to aircraft structure does occur and can adversely impact structural integrity

## C-130 Hercules Birdstrike Detail

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## Thunderbirds: T-38 Formation Loop and Crash at Indian Springs Auxiliary Field



18 January 1982

- 'Diamond' aircraft 2-1-3-4 were in a line-abreast fingertip formation loop
- Thunderbird-1 receiving faulty G-meter instrument readings
- Insufficient altitude and insufficient G-force on backside of loop for an intended wings level recovery at 100 feet AGL
- All 4 aircraft impacted the ground in a precise, tight formation
- 1982 Show season cancelled (U.S. Congress Resolution 248)
- Thunderbirds (alternative name for "Phoenix") transitioned to F-16 Falcon

The Thunderbird "Diamond" are the 4 core airplanes: Lead (1), Left Wing (2), Right Wing (3), and Slot (4). As an aside, Slot flies upside-down, behind and triangulated by the other 3 airplanes. Airplane 5 is Lead Solo and Airplane 6 is Opposing Solo. Airplanes 5 & 6 divide their roles between augmenting the "Diamond" formation and demonstrating the maneuverability and artistry of what a jet airplane can do.

With Lead Solo and Opposing Solo setting-up for their next maneuver, the "Diamond" pulled into a line-abreast, fingertip formation and initiated an inside loop.

After much Congressional debate – much of it to terminate military flight demonstration teams as having "no value" – cooler heads prevailed and Resolution 248 was passed authorizing precision military aerial demonstration teams to continue in perpetuity.

The Thunderbirds (an alternative name for the mythological Phoenix) arose from their ashes with the all-new, frontline fighter, F-16 Falcon in an incredible paint scheme as their demonstration plane. All former Thunderbird pilots still on active duty were asked to come back to this special duty assignment and rebuild the team, to include new maneuvers that would showcase the F-16's flight capabilities and American aeronautical technology at its best.

The Navy Blue Angels were allowed to trade-in their A-4 Skyhawk trainers for their new F/A-18 Hornet (keeping the same Blue and Gold paint scheme). The "Blues" introduced the "Twinkle" maneuver as one of their "Wow!" factors.

## Maintenance Functional Check Flight



- Pilot dual qualified in F-4 Phantom and F-16 Falcon for checking either aircraft after maintenance and before return to regular flight operations
- Ideal job conditions for weekly, daytime flying and home life with his wife who was a maintenance squadron commander
- Although not a TPS graduate or member of Edwards AFB test flight community, pilot acted with bravado of one, even though he performed routine status check flights
- 28 January 1986 while the Challenger Space Shuttle was taking-off from Cape Canaveral, pilot was taking-off from Tampa (MacDill AFB) in an F-16
- At FL200, the Falcon went out of control...

41

Maintenance functional check pilots are good, dependable, solid pilots who understand the airplane and its systems. It's a prestigious assignment because you get to fly almost daily without having to go through the "drudgery" of the flying squadron's day-to-day sorties, yet being able to deploy and fly in the ORI (Operational Readiness Inspection).

The Wing had both the F-4 and F-16 because it was programmed to transition from the Phantom to the Falcon over the next 14 months. The mishap pilot was qualified in both airplanes and was one of the first pilots checked-out in the F-16. Doing maintenance check flights allowed him to keep currency in both jets. The purpose of these check flights is to make sure the flight controls work properly, the engine works properly, and avionics work properly – nothing more, nothing less.

The mishap pilot did something at around FL200 that induced a series of cascading problems in the F-16.

The maintenance officer / widow was asked a number of questions about her relationship with the mishap pilot to include the previous 72-hours; and neighbors were also interviewed.

Because of the Challenger mishap, the Falcon rested in the Gulf of Mexico for 6 months. The "black box" has never been found. The ejection seat has several "chips" to include one that gives airspeed and stops at 847 knots TAS. One of the investigators calculated the Falcon was at Mach 2 when the pilot ejected.

## Same Day and Opposite Coast from the Challenger



- The F-16 began to tumble
- The titanium Pratt & Whitney F-100 engine developed an internal supersonic “air buzz saw”
- Temperatures got so high that the F-100 began to melt (Titanium melts at 1,668° C)
- The melting engine exited the right aft section of the airplane
- Pilot ejected at 5,000 feet while airplane was supersonic: 847 knots TAS from a chip recovered from the ejection seat
- Pilot’s arms and legs experienced “auto flail” and he received numerous fractures in each appendage bone segment
- Automated features of parachute deployment, safety raft, and survival kit worked perfectly
- Rescue HC-130 on a routine sortie reached pilot in under 20 minutes and a “PJ” jumped from cargo ramp of the Hercules into the Gulf of Mexico

42

This mishap became part of the Flight Safety Center mishap lab given many unusual characteristics that it presents, to include composite components and the titanium engine meltdown.

Placing and posing a person into the picture provides perspective on relative part size

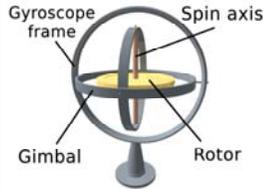
The PJ or pararescue jumped from the cargo deck of a C-130 Hercules from ~20 feet above the light sea swells as the pilots flew the Herc at 10 knots above stalling speed. The PJ found the pilot face-down in the water suspended between his parachute and life raft. The PJ, while treading water and supporting the mishap pilot, administered artificial respiration until a rescue helicopter arrived 45 minutes later. The medics took over and the pilot was pronounced DOA at MacDill hospital by a flight surgeon.

The Air Force puts tremendous resources into bringing our aircrews back alive, whether peacetime or armed hostility.

## Gyroscopic Guidance: You Bet Your Flight Pay

10 November 1986

30 NM Northwest of Prince George, BC



- Attitude Heading Reference System (AHRS) is the primary flight control box in every single Air Force aircraft
- During an autopilot climb from FL330 to FL350, in Day VMC, the T-43 autopilot began “pulsing” the control yoke followed by sudden flight instrument failure with attitude indicator rolling inverted as the airplane entered a spin
- Pilot used needle-ball-airspeed technique to stop the spin and recover control of airplane at 14,000 feet MSL in a valley between two mountain ranges
- Airplane recovered to Vancouver International using the “standby” partial panel instruments
- Aircraft Damage: “Oil canning” of left stabilator
- Cause: Depot procedure in overhauling AHRS gyro
- **Footnote:** Rare instance where FSO, with strong General Officer support, continued the AHRS investigation an additional 14 months to discover root cause and resolve the AHRS issue given its presence Air Force wide 43

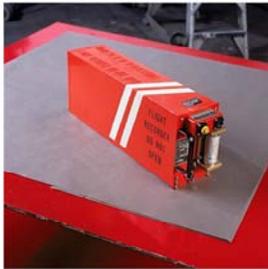
The pilot was within 6 months of retirement and had spent most of his career flying a variety of C-130 missions and profiles. The co-pilot was a top-graduate from his pilot class and retained by Air Training Command as a FAIP – First Assignment Instructor Pilot – in the T-38, testimony to his skill and capability.

The “backend” of the T-43 was occupied by Instructor Navigators of the Air Force and Navy – 6 Senior instructors and 12 instructors going through “seat training” before being assigned their own coterie of students.

The pilot did his first needle-ball-airspeed spin recovery since T-37 training some 20 years earlier. The pilots flew the airplane to Vancouver International because it was the closest airfield capable of accommodating an airplane of this size.

The FSO, with strong general officer support, concurrence and “push” from the Flight Safety Center, continued to investigate and analyze the AHRS gyroscope. The maintenance depot at McGuire AFB, NJ performed AHRS gyro overhauls and when done, shipped the unit with the gyro at the “3 o’clock position”. Bench testing consistently showed that the gyro could go to the 6 o’clock position, to include following 2 hours of “normal” operation. However, by shipping the gyro locked between the “10 to 2 o’clock positions” the gyro would always erect at the desired 12 o’clock position.

## “Black Boxes” – CVR and FDR – Are Actually Orange



- The Cockpit Voice Recorder has 4 channels
  - Pilot (Captain)
  - Co-pilot (First Officer)
  - Air Traffic Control (ATC) radios
  - General flight deck compartment
- Flight Data Recorder – minimum FAA requirement is to measure 88 different factors, although many FDR measure over 160 factors
- Boxes located in empennage and designed to withstand crash G-forces, temperature extremes, and all aqueous environments
  - Battery life runs 72 hours
- Black Box role has evolved from ancillary support to primary investigative tool of all investigations when installed

44

Black Boxes initially served as secondary backup to examining wrinkled hulls and damaged components. Over the years, the Black Boxes have become the primary instrument and tool for analyzing “what went wrong”.

Anecdotal: when the CVR was first being deployed and a conversation took place with the Russians, the Russian stated that they have had cameras with sound since the beginning! And there was no question of who did and said what!

The black box bodies are made of heavy and durable material to withstand crash forces. Current engine technology will not support an airplane made to black box specifications being able to fly, let alone be controllable if airborne.

In the Egypt Air 990 crash following take-off for JFK (31 October 1999), the black boxes revealed the pilots were fighting each other for airplane control and in the process made the situation much worse. Had one pilot handled the flying portion of the emergency, the Boeing 767 would have safely recovered and been able to make it into JFK.

## Navy Aviation



Lockheed P-3 Orion



Aircraft Carrier Fan Tail



Grumman A-6 Intruder



Grumman F-14 Tomcat 45

Naval Aviation is rich in capability, experience, and lessons learned from safety investigations

The above aircraft play a role in the next series of slides

## The PEST Factor

### Political – Economic – Social – Technological



When good intentions “pestate” leadership and aircrew into failure via political, economic, social, and technological modalities to make a point

- LT Kara “Revlon” Hultgreen and the F-14
  - USS Abraham Lincoln (San Diego)
  - 25 October 1994
- Captain Lisa Nowak and the Space Shuttle
  - 7 February 2007
  - “Houston we have a problem...”



46

In the 1980s, Members of the U.S. House of Representatives – Barbara Boxer (Millbrae, CA – a suburb of San Francisco) and Pat Schroder (Colorado Springs, CO) – were leading proponents of “women's’ rights” in commerce and government, especially the military. Both openly chastised men, particularly senior military officers and members of the service secretariat, as being responsible for holding women “back”.

Against this backdrop, Kara Hultgreen and Lisa Nowak applied for and were accepted into premiere aviation jobs within the Navy.

Lt Hultgreen left the P-3 community to fly carrier jets. She wanted the very high performance F-14, and would not consider the A-6 which had “gentler” handling characteristics and a Naval Flight Officer (NFO) to her immediate right. Lt Hultgreen wanted to be THE pilot on future space missions and knew that carrier flight ops in the hottest jet were her career building opportunity. On the mishap day, “Revlon” was low on approach to the carrier, had a compressor stall, was “lazy” on the rudders when she went to afterburner on the functioning engine, and subsequently crashed into the carrier’s fan tail as she lost aircraft control. The NFO ejected safely. Her P-3 records indicated numerous incidents of being “slow” on rudder authority.

Captain Nowak also had transport time before her special duty assignment with NASA and the space shuttle. As with Lt Hultgreen, performance and behavioral idiosyncrasies were overlooked and allowed to continue. Although there was no fatality, this Rockville, MD native lost her husband and children through divorce and only allowed to have supervised visits. In August 2010, a Navy Board of Admirals reduced her rank from Captain to Commander and discharged her from the Navy. A number of psychological factors elicited in testimony made many of Ms Nowak’s hearings “closed”.

These incidents demonstrate where the “system” set-up otherwise capable aviators to “fail” and was led by women with political agendas for their own gain. Both former Members of the House wasted no time in blaming the Navy and NASA for each woman’s failure – while conveniently not mentioning the number of brow-beating sessions, phone calls, and letters sent to the respective government managers “threatening” budget reviews, program cancellations, etc

## B-52H Fairchild AFB (Spokane, WA)



24 June 1994 (7:30 PM local)

~ Earlier Base Distraction ~

On June 20 (Monday) a discharged airman, Dean Mellberg, shoots-up hospital (4 dead and 23 wounded)

- Practice for Saturday airshow
- Mishap pilot (Lt Col) known for his aggressive flying and grand standing
- All "Lt Colonel" crew
  - Experience ≠ Currency
- Buff receives clearance for 360° turn because a KC-135 is on runway
- Enters "accelerated stall" at 250 ft AGL
- All aircrew fatal – fireball consumed ejecting co-pilot (squadron commander)
- Deputy Commander of Operations convicted for "dereliction of duty"
  - Turned a "blind eye" to:
    - Flying regulations
    - Leadership in subordinates
  - 1<sup>st</sup> Uniformed top-management accountability for "command influence"

47

In 1982, Fairchild AFB experienced a fatal airshow crash between a B-52 and KC-135 during a formation position change at 500 feet above the airfield. The pending 1994 airshow was its first use of Wing assets in a flying demonstration.

The actual crash can be viewed on "You Tube" – just type "Fairchild B52 Crash" to bring up the video.

The pilot was a hard-charging, extreme risk-taking Lt Col that crew members did not want to fly with. However, he was very dependable for good results on the ORI. He was on yet another one of his many "probations" and could only fly when the Lt Col Squadron Commander was with him in the airplane, as was the case on the mishap day.

Because a KC-135 was on the runway, the B-52 could not land. The pilot asked for a 360° turn in place, which Tower approved. The pilot then proceeded to turn the B52 in a tight turn more suited for the F16. He proceeded to put the airplane into an accelerated stall, lost flying speed while in 90 degrees of bank, and "crashed". The co-pilot (Squadron Commander) successfully ejected but was consumed in the ensuing fireball of the crash. This video shows how an airplane laden with fuel leaves no remnants (a point for 9-11 conspiracy theorists to remember).

The Safety investigation determined the aircrew knowingly exceeded all aircraft performance capability.

The Deputy Commander for Operations (DO) was found in a separate hearing to be "negligent" and guilty of "dereliction of duty" in fostering flying discipline and keeping good order.

As with the KC-135 1988 mishap at Valdez, AK, the regular crew got "bumped" by senior officers needing end-of-year flying time. These senior Lt Col and Colonels flew an approach into Valdez clearly annotated "STOL Aircraft Only". The KC-135 has never been STOL capable under any configuration. The B52 requires 8 minutes – and lots of airspace – to execute a 360 degree turn.

## Attitude & Speed Control on Approach to Landing

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- DC-9 Landing with passengers
- Attitude Performance
- 6 Degrees of Freedom
- Pilot needs to control:
  - Runway alignment
  - Airspeed
  - Rate of Descent

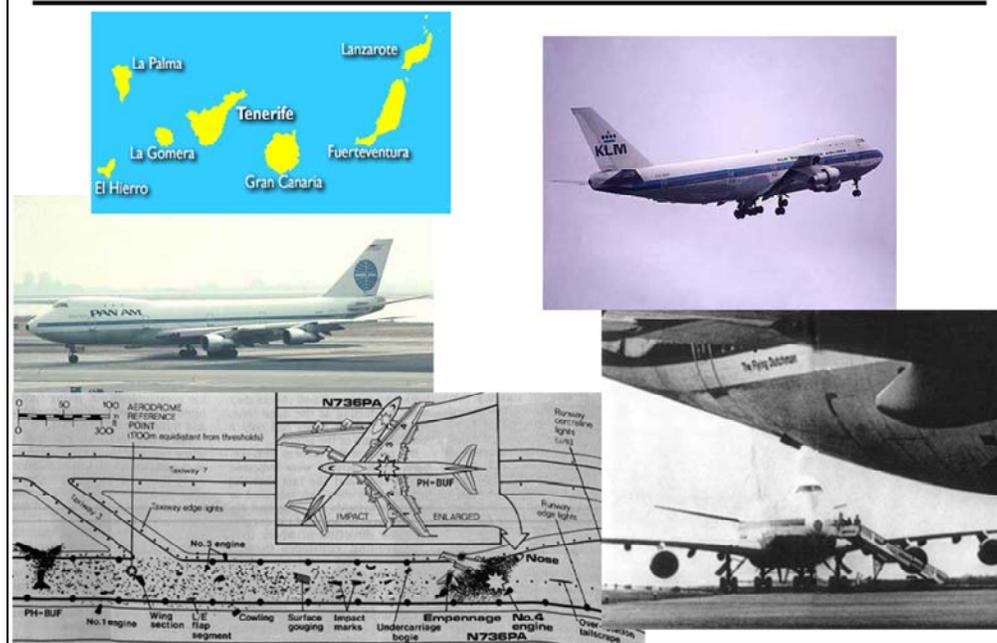
Behold an approach and landing...

48

The DC-9 is a rugged work horse within the airline industry

If the pilots get too ham-fisted, this is what happens...

## Tenerife, Canary Islands 27 March 1977 – Foggy Afternoon



Grand Canary Island Las Palmas airport was closed because of a bomb explosion and airlines were diverted to Tenerife and its Los Rodeos airport. (As an aside, Lanzarote is where the 1983 heroic fantasy film, *Krull*, was filmed).

On the mishap afternoon, two B-747 were back-taxiing on Rwy 30 for takeoff to Las Palmas, which had just reopened. PanAm was following KLM. Sudden fog came in and PanAm got “lost” on the runway and did not turn off on Taxiway 3 as instructed. KLM captain took it upon himself to takeoff without verifying PanAm had cleared the runway. Moreover, KLM had **NOT** been cleared to takeoff by Tower. KLM, Captain Jacob van Zanten wanted to comply with the very strict company rules about crew duty day. Captain Van Zanten was the top 747 pilot for KLM.

PanAm crew under Captain Victor Grubbs saw approaching KLM jet and tried to get off runway into grass.

KLM crew saw PanAm as they were building airspeed and tried to “jump” their jumbo over PanAm. KLM tail dragged and sparked on runway; aircraft gained 1 meter of altitude before impacting PanAm at 1706 hours (local and GMT).

## Tenerife: ATC Clears 2 Boeing 747 Aircraft to be on Same Runway as Fog Enshrouds Airfield

KLM Rwy 12  
Takeoff

Computer  
Simulation



Tenerife continues to hold the dubious distinction as the world's most deadly airplane accident – 583 deaths and 64 survivors



KLM 4805



PanAm 1736

50

Outcomes:

Standardized all international English phraseology and precise instructions

Only 1 airplane on a runway at a time – no “expediting”

Better understanding of “Get-there-it is” by pilots. Both KLM Captain and PanAm Captain were spring-loaded to get to Grand Canary International Las Palmas Airport and common sense, and sound aeronautical decision-making were missing

Tenerife Controllers wanted to “empty” their airfield of all the airliners diverted from Las Palmas

Tenerife opened a much better, newer airport in 1979 that had been driven by tourist and passenger demands to be closer to the resorts on the southside of the island and avoid the 2 hour drive!



## Jimmy Carter's Debacle in the Iranian Desert



**24 April 1980**

- Joint Force Rescue Attempt: "Operation Eagle Claw"
  - 53 Hostages from State Department
- Pilots from Army
- Ground Rescue by USN-USMC SEALs
- USAF C-130
- 8 Sea Stallions from USS Nimitz in the Persian Gulf
  - Sikorsky RH-53 (S-65)
  - 2 Aborts
- 8 Fatalities following crash from RH-53 air taxi into EC-130
- 5 RH-53 left in Iran
- MC-130 evacuates to Wadi Abu Shihat followed by C-141 medical transport to Ramstein Air Base

Jimmy Carter, 39<sup>th</sup> President of the United States, is perceived as "weak", vacillating, and incapable of making a decision

Iranian dissidents, at the urging of Ayatollah Ruhollah Khomeini, storm the US Embassy and take 53 prisoners. Like Ho Chi Minh (of Vietnam) Khomeini spent many years in exile in France and received many privileges.

President Carter does nothing following the initial crisis. Military has a "plan", but will need soil samples. CIA flies its "borrowed" T-43 to Iranian desert to get soil samples. Although retired in 2010, the T-43 – a Boeing 737-200, designed for navigator training – had 17 aircraft produced (and became "tipping point" customer for airlines to make it the most popular airliner of all time). Twelve aircraft were based at Mather AFB, CA (Sacramento), 4 at Buckley ANGB, CO (Denver), and 1 loaned to the CIA, #72-0286, the "official" Air Force photo taken over Lake Tahoe during winter with snow on the mountains.

Operation Eagle Claw quickly morphed into a recruiting poster campaign: All the services would be involved. Yet, none of the uniformed services ever practiced together and the participants never did any coordination.

The nature and conditions of "fine sand" were never considered. An Air Force member was visually marshalling at night (no voice comm) a Marine crew in the air-taxiing RH-53. When the Air Force troop was temporarily "blinded" by blowing sand grit, he began stepping backwards, The RH-53 pilot perceived he was drifting backwards, so he corrected by going forward, and struck a parked EC-130 transferring fuel, causing a major desert, night fire. There went the element of "surprise".

## How Many Sea Stallions Were Needed?



- 3 RH-53 Electrical Failures
- MX Records – 20 Hrs MTBF
- No practice before hand... “jointness” came about for “recruiting” ads
- No consideration of “sand storms”
- Actually needed 15 minimum Sea Stallions to depart the Nimitz!

Calculations Are NOW Mandatory

$$R(14) = P(T > 14),$$

where T is exponential with  $\lambda = 1/20$

$$R(14) = e^{-(1/20)14} = 0.4966 \approx 0.5$$

$$P(X \geq 6) = P(X > 6) + P(X = 7) + P(X = 8)$$

$$= 0.1094 + 0.0312 + 0.0039$$

$$= 0.1445$$

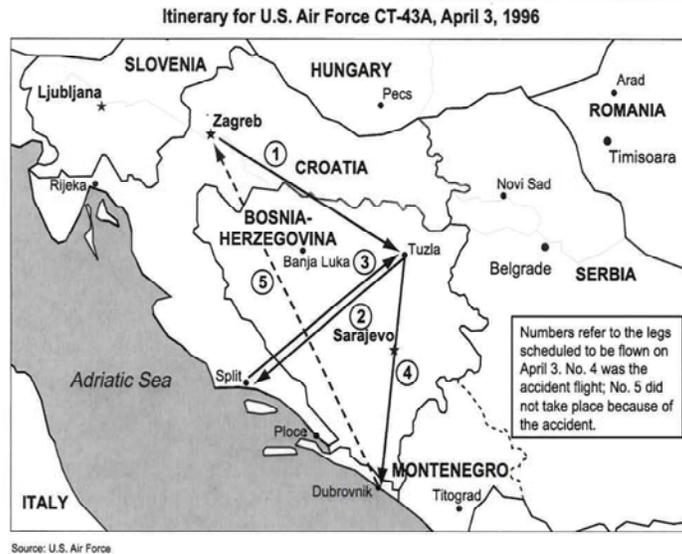
Round-up to 15

53

College professor of aeronautical engineering and Reserve General for logistics, requested and received Sea Stallion maintenance records. He quickly determined the Mean Time Between Failures (MTBF) was 20 hours. With this, he did a Poisson calculation and determined the minimum number of Sea Stallions needed were 15 to just depart the Nimitz!

Such calculations are now mandatory by the Defense Department. Also required are “joint practice exercises” for any contemplated activity.

## Dubrovnik, Bosnia-Herzegovina and Another T-43 (Yugoslavia falls into civil wars after Tito dies)



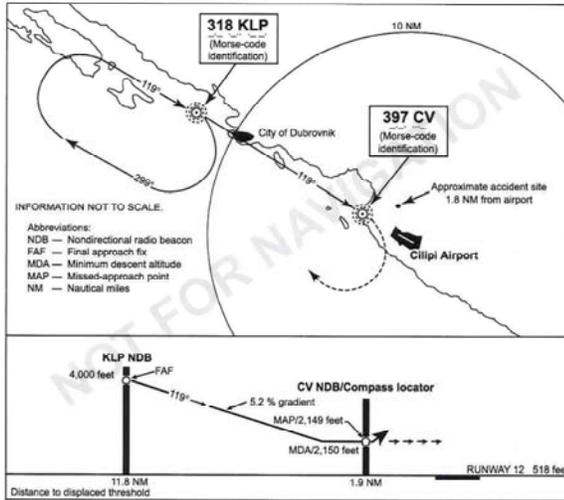
54

President Bill Clinton is working his way through the Bosnia-Serbia and rest of the former Yugoslavia crisis. He has dispatched Secretary of Commerce, Ron Brown, on a trade mission. This is because “trade” and “good economics” make war unnecessary. A T-43, retrofitted from the downsizing navigator training program into an “executive seating” configuration is on “loan” to European operations – USAF-Europe and USAF-NATO. The T-43, as a military version of the commercial B-737 is ideally suited for all air operations throughout Europe.

The above graphic, courtesy of Flight Safety Foundation (FSF), shows the intended flight activity for the day

# NDB Instrument Approach into Dubrovnik

Illustration of NDB Approach to Runway 12, Cilipi Airport, Dubrovnik, Croatia



## FACTS

Requires two (2) separate and independent NDB nav aids to fly the approach

The T-43 (Boeing 737) has a grand total of one (1) NDB

US Air Forces in Europe (USAFE) issued the T-43 crew a special written waiver to fly and land throughout Europe on approaches below HQ Air Force published approach and landing minimums

55

Cilipi Airport, outside of Dubrovnik has an NDB approach. When it comes to approaches, the NDB is the least sophisticated, yet easiest to maintain from a cost and labor perspective.

This particular NDB approach into Dubrovnik requires two (2) separate and distinct NDB instruments be in the airplane. The T-43 has a grand total of one (1) NDB.

When doing instrument approaches, the following philosophy and “rule” holds true: the more precise the approach media, the lower the approach minimum and the less precise the approach media, the higher the altitude.

Headquarters, USAF in Europe (USAFE) to give the T-43 maximum latitude and flexibility in operating throughout Europe issued the crew a special waiver letter to go to altitudes below Air Force published minimums. The crew, which had flown once before into Cilipi, opted to use their waiver to initiate the approach – which was below published minimums (and a no-no for Air Force operations) – and fly the NDB, even though they had but a single unit when two (2) were clearly required.

## T-43 Impacts Terrain at 120 KIAS



- Crew had previously flown into airport once in day VMC
- Crew attempted to fly the approach on the T-43's single NDB
- Crew recognized their dangerous position following a brief "peak" through the clouds / fog
- Impact occurs 75 feet below the mountain top in a climb
- Secretary of Commerce, Ron Brown, is the key passenger on a trade mission from President Bill Clinton
- Tremendous "command influence" is on the pilots to make Brown's itinerary and schedule happen
- Mishap investigation becomes a political football
- Finding / Cause / Remedy: HQ USAFE – to include its 4-Star General Officers – cannot lower HQ Air Force minimums

The pilot crew realized through cloud breaks where they were and initiated an immediate climb to get back up to altitude and plan a more viable strategy. Unfortunately, their decision to abort the approach and execute "missed approach" came too late. They impacted a mountain 75 feet below the summit in a 14-degree nose-up attitude (ideal for aborting an approach and optimal climb out). All were killed upon impact except for an Air Force sergeant who expired during an air ambulance evacuation to the hospital.

After a lot of politics on who would investigate – NTSB or Air Force – the Air Force Flight Safety Center was selected. The key findings were that the NDB approach cannot be considered as a viable approach without appropriate equipment and the crew was better trained than to make such a dumb decision. More importantly, the safety investigation cited HQ USAFE as a significant contributing factor by issuing a waiver to allow their air crews to operate below published Air Force minimums. The Safety Board issued a very strong statement citing that Air Force published minimums are the lowest acceptable minimum, no command can lower that minimum, and any command may make the minimum higher based upon aircraft, air crew, operating theater.

## The 1<sup>st</sup> and Only T-43 Destruction – 100% Preventable



- Aircraft 73-1149 before and after photos
- 1149 Received new paint job when it was “pulled” from the downsizing navigator training program and reassigned to “executive transport”

- Aircraft Commander had many years of KC-135 flight time
- Co-pilot was a former T-38 Instructor Pilot on his second assignment (and trained by the top T-43 IP of all time)



Before and after pictures of T-43, serial number 73-1149

## The Passionate USAFA Cadet Pilot



- Good student, working on private pilot license
- Wants to attend SUPT and become a fighter pilot
- Incident #1: Cadet reported rough air while doing ground reference maneuvers
- Incident #2: Cadet reported fuel starvation from a leak not detected during preflight (two weeks after 1<sup>st</sup> incident)
- The “Billy-Jeff” Factor (without compartmentalization) in action

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The rest of the story with the “passionate cadet” is as follows:

Cadet learned he had impregnated his girlfriend prior to taking his mishap sortie #1. The cadet was NOT supposed to be involved in a romantic relationship or have a steady girlfriend at his particular stage of training.

Just prior to Mishap #2, Cadet learns he is going to be a father for a second time and with a birth very close to his pregnant girlfriend’s delivery! The mother-to-be is his girlfriend’s mother! Talk about keeping it all in the family! ☺

The cadet was obviously following the examples and philosophy of his Commander-in-Chief, Bill Clinton, and not that of integrity expressed by his superior Academy officers.

## Sun Valley Mall: Concord, CA – 23 December 1985



- Foggy, 8:33 PM (local)
- Baron traveling from Oakland to Concord with 3 people on board
- Instrument rated pilot last transmission was with Travis Approach before switching to Buchanan Field Tower inbound on 19R
- Pilot lost control (stall) on missed approach climb into dense clouds and impacted glass ceiling of the 3 story mall filled with Christmas shoppers
  - Napalm drop in 'Nam similarity
  - 83 Treated for burns / cuts
  - 4 Burn fatalities
- Insurance company made the entire \$5 million policy available in March 1993

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Jim Graham (67), pilot had a lifelong career in aviation beginning with the US Navy in WW2. His two passengers, along for the ride, were Jack Lewis (48, financial advisor) and Brian Oliver (23, part-time employee when not at Diablo Valley College). Graham's Baron (N1494G) was kept in excellent operating condition and insured by Associated Aviation Underwriters (AAU), which was jointly owned by the Chubb Group and Continental Insurance since its 1929 founding. The underwriter was the Assistant VP for Northern California and former Navy pilot assigned to Neptune sub-hunters, John P Middleton.

### Fatalities:

Pam Stafford (22) - was getting fitted for wedding ring; with burns to over 80% of her body, life support was disconnected on Dec 24 and she expired quickly and quietly

Alexander Luong (Age 14 months), passed away December 29

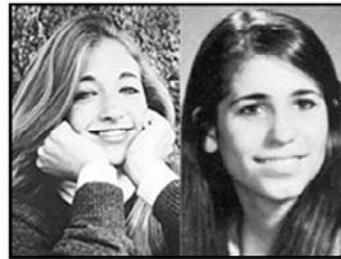
Chandrika Shah (49) died 2 weeks later

Patricia Joanne Larson (45) died 7 weeks later

Sun Valley Mall continues to operate as does Buchanan Field at the same locations as on the mishap day.

Sidenote: The present day location of Buchanan is its third venue since its founding with prior moves accomplished to keep it separated from encroaching civilization. Buchanan is bounded by the Sacramento River to the north, oil refineries to the west, golf course to the south, and hills/light industry to the east.

Piper Saratoga PA-32R  
16 July 1999, N9253N



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John Kennedy – John-John as America remembered the little boy of the late President – was always fascinated by airplanes. He learned how to fly in a Cessna 172 Skyhawk and promptly purchased an ultra sophisticated Piper Saratoga upon getting his private license.

As publisher of “George” magazine, he combined use of his airplane for both business and personal pleasure. Because he broke his foot and was in a cast, he was not able to fly as pilot-in-command for medical reasons – a casted foot cannot operate rudder pedals. Consequently, he hired a flight instructor to accompany him. The flight instructor he used was highly capable because this instructor was also a first officer (co-pilot) for American Eagle, a regional commuter.

On the mishap night, Kennedy’s cast had been removed and he had done a daytime flight solo. However, he had gone well over 90 days for any night flying. The FAA requires 3 landings to a full-stop in the preceding 90 days before allowing passengers to ride. This 90-day landing currency is a self-administered currency that is left to personal integrity.

On the mishap night, Kennedy took off from Teterboro, NJ airport with his wife (Carolyn) and her twin sister (Lauren) well out of night currency. He refused “ride along” assistance from 3 separate flight instructors. He opted not to file a flight plan and opted not to use flight following radar services (all free).

## Saratoga Pilot at Night, Low Visibility, Non-Current



Night Haze  
 ~ No Moon ~  
 Forward Visibility

FAA requires in the preceding 90 calendar days, 3 night landings to a full-stop in order to carry passengers

- Autopilot can fly to center of airfield
- 7 "Clicks" on pilot microphone illuminates ALL runway and taxiway maximum lighting intensity
- Airplane attained "red line" in spin



About 15 NM from Martha's Vineyard, Kennedy opted to take the Saratoga off autopilot and hand-fly the airplane. As a non-instrument rated pilot, he had no visual horizon by which to orient the airplane.

The airplane experienced a stall with subsequent spin. Kennedy did not or was not capable of recovering the airplane from a spin. When the airplane reached and exceeded  $V_{NE}$  – never exceed speed, because it is where the airplanes breaks apart – the airplane did break apart before various pieces came to rest on the ocean floor some 115 feet below the surface.

Had he left the airplane on autopilot, it would have flown to the center of the airfield. At that time, he simply had to click the microphone switch 7 times to get maximum intensity lighting on every runway and taxiway.

## Tracy, CA: CAVU Mid Air Collision 24 August 1989

- Computer animation approved for use in the liability trial by California Supreme Court



Baron (N9750Y) had taken off from Sacramento Executive (SAC) enroute to Santa Maria (SMX) 5,500 MSL 185 knots and 180 degrees track

**“See and Avoid” does not always work**

Cessna (N42695) had taken off from San Rafael (DVO) enroute to Fresno (FAT) and flying SE direction 5,500 MSL 147 knots on track of 118 degrees



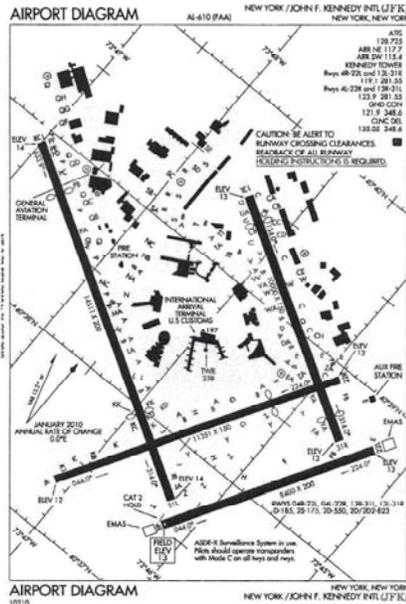
62

How the collision looked from pilot perspective at ~9:30 AM (local)

Santa Maria was the venue for the movie “The Rocketeer” and has maintained a late 1930’s ambiance through the years

San Rafael is Novato (Gross Field)

## JFK Baron Emergency – Handling “Stress”



- Beech Baron (N821BE) advises Center that he is “having trouble” in the clouds and could use some help
  - Commercial pilot, 600 Hours
- Controller initially handles as “routine”
- Delta 623 (DC-10 Captain) recognizes the situation as a severe emergency
  - Automatically orbits NYC at FL240 and talks young pilot through basic aircraft control and recovery
- Both pilots deviated from “routine” which was right thing to do
- Baron’s left aileron disconnected
  - 10,000 Ft altitude loss in 36 seconds!
- DC-10 Captain credited with “Save”



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The Baron pilot failed to say “I am declaring an emergency”  
Goes from Center to Approach to JFK Tower Controller

The DC-10 Captain, on his own initiative, began orbiting NYC at FL240 without clearance, and began talking to the Baron pilot like a friendly flight instructor sitting next to him. It was the DC-10 Captain’s calmness, professionalism, and overall demeanor that got Baron pilot and Controller working together.

Delta does not authorize or approve its Captains doing such a stunt. ATC does not allow airliners full of passengers to just start orbiting without clearance. Yet in this particular case, it was the only thing to be done and both the FARs and Airline Regs allow for this type of deviation to handle an emergency.

## Imitating NASA at a Non-Towered Airport



12 Dec 1999 (Sunday) Plant City, FL



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NASA specially modified a B-747 to transport the DC-9/MD-80 sized Shuttle from any landing spot in the world back to Cape Canaveral for its next launch.

Pilots operating at non-towered airports always talked about the low wing aircraft landing on top a high wing aircraft because this was the worse possible combination: low wing pilot cannot see down; high wing pilot cannot see up.

Well, it happened and fortunately everyone walked unhurt! A “new” private pilot was in the Piper. A student pilot with instructor was in the Cessna. The instructor landed both airplanes. The Piper was displaced to the right so that it’s propeller did not penetrate the Cessna.

The Piper pilot was able to return to his home airfield. He was assigned 10 hours of additional dual instruction with a carefully selected instructor in lieu of license suspension or revocation.

The flight instructor received a significant flying safety award, that in part cited his 25 years of flight instruction accident free. The Cessna required only minor repairs.

As for the student pilot, she earned and received her Private Pilot License 12 days later on December 24, 1999 just before noon!

## Eastern Airlines Flight 401 and the L-1011

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L-1011 TriStar



Advanced Jumbo Jet

- New York to Miami flight went in holding over the Everglades because of a nose-gear light not illuminating on 11:32 PM approach
  - 29 December 1972
  - Airplane 4 months old
- No one on flight deck was consciously flying the airplane
  - 4 Pilots fixated on landing gear position light
  - No one cross-checking altitude of 2,000 feet
  - Everglades is a “black hole” – no reference lights all directions
- Maintenance had replaced an inoperable L-1011 control yoke with a B-727 control yoke
- B-727 control yoke movement disengages L-1011 autopilot at 14 pounds of pressure vice 27 pounds of pressure for the L-1011 yoke
  - Captain (#50 on line list) leaned into yoke, disengaging it
- Everglades “muck” absorbed impact energy and stopped bleeding
  - Microbes in muck caused other health concerns
- CRM – Cockpit Resource Management initiated post-crash

## C-5 Galaxy

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- Largest airplane in the entire Air Force fleet
- Based at Travis AFB, CA and Dover AFB, DE
- Dover Reserve crew departing for the Middle East in one of the 33 (down from 77) C-5 airplanes is the story of interest, but first some facts...

66

Lockheed Aerospace is the leader in transport cargo aircraft, beginning with the C-130 Hercules, the most widely sold and used transport in the world. Lockheed created the first all-jet transport with the C-141 in 1963 and the Air Force accepted it as fully operational in 1965. Leveraging the C-141 design, Lockheed created the C-5 Galaxy in 1968 with it becoming operational in 1970.

The C-5 cargo compartment is 19 feet wide, 13.5 feet high, and 121 feet long

## C-5 Facts



- Becomes operational 67 years after Orville and Wilbur proved manned flight possible
- Entire flight of Orville and Wilbur could occur inside the fuselage's cargo bay... with room to spare
- C-5 can hold and airlift:
  - 2 M-1 Abrams tanks
  - 19 Greyhound buses
- C-5 Galaxy fuel weight alone equals the entire maximum gross weight of its smaller and "middle" brother, the C-141 Starlifter
- It's the ultimate strategic airlifter in terms of capacity and ability to be air refueled
- Mishap crew experiences failure of Engine #2 ...

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Failure of Engine 2 is no cause for alarm... the airplane still flies safely

Unfortunately, the mishap crew (instructor qualified) had not computed an engine loss speed nor had they computed the amount of fuel necessary to burn or jettison for a normal landing

Consequently they had no target airspeed, touched down too heavy and too fast

No fatalities, no serious injuries (some sore muscles and jolting)

And on a rainy 4 April 2006 morning...



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Pictures tell the story

## Ejections and Mishaps

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- Ejections 2,000 feet AGL and higher
  - 95% Survivability rate
- Ejections < 2,000 Feet AGL
  - < 90%
- Mishap Rate per 100,000 hours of flying time
  - 1947 45.00
  - 1986 1.47
  - 2009 1.32

69

The improvement of ejection seats technologically plays a key role

The biggest driver in the improving mishap rate was going to jet engines and having pilots be assigned a single airplane type

The jet engine has 1 moving part: the long shaft

The reciprocating engine has 4,876 moving parts – more opportunity for something to go wrong or mask a more serious problem

Being assigned to a single type of airplane allows a pilot to be totally focused on all its operating parameters and be a complete expert

## Alcohol Consumption and Pilots

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- Air Force: Demonstrate no adverse effect
- FAA: “8 hours Bottle-to-Throttle” rule
- U.S. Navy (December 1986) – Simulator study with Control Groups
  - Aircraft: P-3 Orion and F-14 Tomcat
  - 3 Phase Assessment
    - Phase I – All pilots perform a flight profile to include a routine emergency and instrument approaches
    - Phase II – All pilots (other than control group) consume alcohol and attain blood-alcohol content of 0.10
      - Pilots perform Phase I flight simulator profile
    - Phase III – assess pilot performance for next 10 days following Phase II completion
      - Pilots perform Phase I flight simulator profile

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This slide addresses the image of the booze chugging, skirt chasing, psychopathic pilot of Hollywood

There are “guidelines and rules” in place

The Navy did a very good study to generate quantitative data. After 3 days (72 hours) of becoming inebriated, it was a matter of personal metabolism, DNA and lifestyle relative to residual effects of alcohol being in the body system.

When drunk, pilots could not fly the airplane.

Following 8 hours, pilots could not handle emergencies

Took 72+ hours to be able to fly the airplane AND handle emergencies

Very few pilots make the news for “drinking” before a flight because the pilot community is highly conservative when it comes to safety and follows the regs. You read about the aberrant fringes, not the mainstream.

## Insurance Hull Rate Table – MBB Project

INSURED VALUE	HULL RATES:		MEDIUM TWIN	
	Beech 58TC, 58P Cessna 414	Cessna 421 Piper PA31 Navajo	Cessna 401 Cessna 402 Commander 500	Beech Duke Piper PA60 Aerostar All Other Commanders All Others
Up to \$75,000	\$3.50	\$5.00	\$6.25	\$7.50
\$75,000 to \$95,000	\$2.50	\$3.50	\$4.38	\$5.25
\$95,000 to \$115,000		\$1.50	\$1.88	\$2.25
\$115,000 to \$135,000		\$1.40	\$1.75	\$2.10
\$135,000 to \$155,000		\$1.30	\$1.63	\$1.95
\$155,000 to \$175,000		\$1.22	\$1.53	\$1.83
\$175,000 to \$195,000		\$1.16	\$1.45	\$1.74
\$195,000 to \$215,000		\$1.10	\$1.38	\$1.65
\$215,000 to \$235,000		\$1.07	\$1.34	\$1.61
\$235,000 to \$255,000		\$1.04	\$1.30	\$1.56
\$255,000 to \$275,000		\$1.01	\$1.26	\$1.52
\$275,000 to \$295,000		\$0.98	\$1.23	\$1.47
\$295,000 to \$315,000		\$0.95	\$1.19	\$1.43
\$315,000 to \$335,000		\$0.93	\$1.16	\$1.40
\$335,000 to \$355,000		\$0.91	\$1.14	\$1.37
\$355,000 to \$375,000		\$0.89	\$1.11	\$1.34
\$375,000 to \$395,000		\$0.87	\$1.09	\$1.31
\$395,000 to \$415,000		\$0.85	\$1.06	\$1.28
\$415,000 to \$435,000		\$0.84	\$1.05	\$1.26
\$435,000 to \$460,000		\$0.83	\$1.04	\$1.25
\$460,000 to \$490,000		\$0.82	\$1.03	\$1.23
\$490,000 to \$525,000		\$0.81	\$1.01	\$1.22
\$525,000 & Over		\$0.80	\$1.00	\$1.20

## Corporate Jet Performance Summary Tables (MBB)

Model	DIMENSIONS			ENGINE		Pax			DISTANCE		SPEED		Fuel	WEIGHTS				Number in Service
	Length	Width	Ht - Int	Model	Thrust	Alt	Seats	Range	T/O	Lndg	M	mo Cruise	Load	Ramp	T/O	Lndg	Zero	
<b>Beechcraft</b>																		
400A	48.4'	43.5'	4.8'	P&W JT15D-5	2900	45	7/9	1635	4082	2830	0.78	447	4,912	16,300	16,100	15,700	13,000	67
<b>Cessna Citation</b>																		
500	43'6"	47'		P&W JT15D-1B	2200	41	6/7	1131			0.7		3,780		11,850			336
	Citation I																	
525	42.6'	46.8'	4.8'	R-R/Wm FJ44-1A	1900	41	5/6	1275	2960	2800	0.71	380	3,220	10,500	10,400	9,700	7,900	20
	CitationJet																	
550	47.2'	52.2'	4.8'	P&W JT15D-4	2500	43	6/11	1662	2990	2270	0.71	374	4,972	14,300	14,100	13,500	11,800	832
	Citation II																	
550B	47.3'	52.2'	4.69'	P&W PW530A	2750	43	2/7	1900	3400	3010	0.7	394	4,860	14,500	14,300	13,500	11,000	
	Bravo																	
560	48.9'	52.2'	4.8'	P&W JT15D-5D	2900	45	7/13	1596	3160	2920	0.75	427	5,771	16,500	16,300	15,200	12,200	229
	Citation V																	
560XL	52.1'	55.7'	5.7'	P&W PW545A	3640	45	2/8	2055	3414	3315	0.75	430	6,540	18,900	18,700	17,400	13,400	
	Excel																	
650	55.5'	53.5'	5.7'	Garrett TFE731-3C-100	3650	51	7/13	1855	5180	2900	0.83	463	7,329	22,200	22,000	20,000	15,900	202
	Citation III																	
660	55.5'	53.5'	5.7'	Garrett TFE731-4R-2U	4000	51		2710	4900	2700	0.82	462	8,700	24,200	24,000	20,000	16,400	30
	Citation VII																	
670	58'8.5"	59'0"	5'10"	Garrett TFE731-4	6000	51	8/15	3004	5100	2900	0.9	513	13,000	34,800	34,500	31,000	23,000	2
	Citation IV																	
750	72.2'	63.9'	5.7'	Allison AE3007A	6000	51	8/15	3004	5100	2900	0.9	513	13,000	34,800	34,500	31,000	23,000	2
	Citation X																	
<b>Gulfstream</b>																		
II	79.9'	71.7'		RR Spey Mk511-8	11400	43	12	3361			0.85		26,800	65,900	65,500			246
	III																	
III	83.1'	77.8'		RR Spey Mk511-8	11400	45	14/19	3728			0.85	488	28,300	70,200	69,700			178
	IV																	
IV	88.3'	77.8'	6.1'	RR Tay Mk 611-8	13850	45	14/19	4033	5280	3386	0.88	480	29,280	75,600	74,600	66,500	49,000	209
	V																	
V			6.1'					6500			0.8							0

## Insightful Safety Quotes

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- I've never had an experience of leaning to respect two people more than I do the Wright Brothers. They were innovative. They couldn't be stopped. And they were so open minded that no matter what problem presented to them, they found a solution.  
~ Scott Crossfield
- Never fly the 'A' model of anything. ~ Ed Thompson
- Never put yourself in a situation where a pathologist administers your final flight physical.  
~ Chuck Yeager
- When a prang seems inevitable, endeavour to strike the softest, cheapest object in the vicinity, as slowly and gently as possible. ~ RAF pilot advice during W.W.II
- If you're faced with a forced landing, fly the thing as far into the crash as possible.  
~ Bob Hoover
- You're not scared... there's got to be an opening, there's got to be a backdoor.  
~ Scott Crossfield
- You've got to expect things are going to go wrong. And we always need to prepare ourselves for handling the unexpected. ~ Neil Armstrong
- That's what we're trained to do. ~ Chesley B. 'Sully' Sullenberger III

## Insightful Safety Quotes

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- Always know where your nose is relative to the horizon, along with the requisite thrust and control inputs to maneuver the aircraft to a stable, wings level attitude on the horizon... and keep it there. ~ Gregg Monaco
- Landings. A good landing is any landing from which you, the pilot, can walk away from unassisted. A great landing is one in which the airplane can immediately be used again. ~ Anonymous
- It's a very sobering feeling to be up on a test flight and realize that one's safety factor was determined by the lowest bidder on a government contract.  
~ Alan Shepard

**MAINTAIN AIRCRAFT CONTROL**  
**STOP – THINK – COLLECT YOUR WITS**  
Aviate – Navigate – Communicate  
**FLY THE AIRPLANE**

~ Section 3, Page 1  
Air Force Tech Order for EVERY Airplane

## Contact Information

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Gregg Monaco

[gMonaco@csc.com](mailto:gMonaco@csc.com)

[GreggMo@yahoo.com](mailto:GreggMo@yahoo.com) (ASQ contact)

703-767-7928 (Government Desk)

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