

## AIRSHOW ACCIDENT REVIEW 2014

Des Barker

**The tenets expressed in this review are those of the author and addresses a sample of significant accidents and incidents at aerial events worldwide in 2014, both during the actual events and during rehearsals and includes, airshows, air races, flypasts, and air capability demonstrations; in fact, any event at which an aircraft is displayed or rehearses for a public air event in which the flow of the event is jeopardised.**

Des Barker

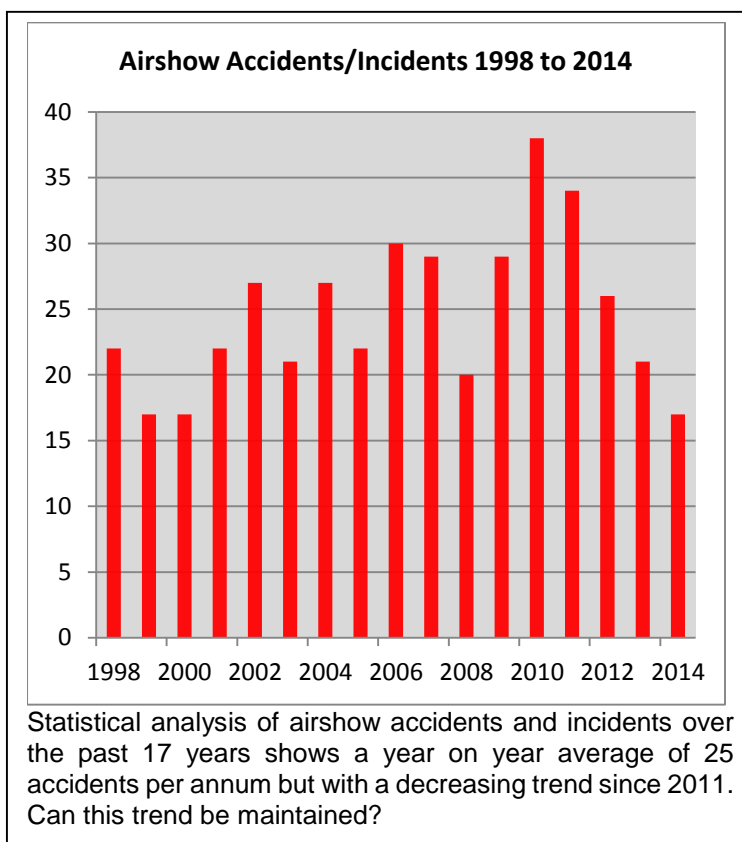
### Introduction

There is a Frank Sinatra song with lyrics: "When I was seventeen, it was a very good year", - 2014 could have been a good year for the airshow community had it not been for the seventeen accidents and incidents worldwide resulting in the deaths of ten pilots and injury to one crew member. Most certainly, it was the best year since 2000 in terms of the number of accidents and incidents and also the fact that there were no injuries to spectators although a passenger died being 'flipped' during a low level display!

As an international airshow community we have continued to reduce accidents and incidents at airshows; decreasing from 37 in 2010 to 17 in 2014. The question over the past three years has been whether the apparent decrease was attributable to some statistical spike or a genuine all-round improvement to airshow safety worldwide from the contributions of the display pilots, safety officers, air bosses, airshow organisers and spectators. Could it just be that the number of air events have reduced? Unfortunately, there are no accurate figures available for the number of air events worldwide, nor the number of hours flown annually from which to draw scientific conclusions.

What is clear however, is that we could not afford to just continue and accept the increasing average of 27 accidents/incidents over the previous ten years. We couldn't afford to just accept what the dice have dealt with the associated loss of life? Based on the fickleness of human judgement in the low level display environment, is it realistic to even believe that zero airshow accidents are possible in a given year?

These questions were put to the European Airshow Council (EAC), the International Council of Airshows (ICAS) and Airshow South Africa (ASSA) at their annual Safety Conventions in 2011. The year 2010 was acknowledged statistically as the worst in recent airshow history and the loss rate was unacceptable and as such, airshow safety oversight organisations were galvanized into taking a more aggressive approach to airshow safety and introduced improved oversight mechanisms and ongoing safety management systems that constantly questioned the environment with the view to identifying hazards and developing mitigating actions. It was pointless to introduce additional regulations, there were already enough in place; what was required, however, was to zero in on human factors across the entire airshow



community, from first responders, through vendors, safety officers and display pilots alike, through a continuous 'in your face' safety programme.

By 2011, the first indication of a reduction in airshow accidents raised the question: "Is this real or just random numerical scatter?" By 2012, a further reduction was apparent and the first indications of a trend towards improved airshow safety statistics was becoming evident which was followed up in 2013 with a further improvement, the lowest accident rate in many years verifying the downward trend. This begged the question: "could we maintain this trend? 2014 certainly appears to indicate that by maintaining an aggressive 'in your face' safety campaign throughout the season it could be possible to drive the rate to single figures at least.

Sadly, and at the expense of melodrama, there is nothing new under the sun. Due to the fickleness of man's decision making, highly experienced pilots have in some cases, continued making the same errors in judgement over the past 105 years of airshows?

### **The Critical Issue of ARFF Response**

One of the most contentious issues raised in the 2014 season, was the aspect of Airfield Fire and Rescue Responders (ARFF). In 2013, there were two cases in which pilots succumbed to post impact fires after surviving the accident, Spanish pilot, Ladislao Romero and South African pilot, Glen Dell. Rapidly responding to the crash scene, first responders heard Romero say: "I am alive but trapped," - it was the last thing they heard from him. The intense heat of the fire prevented fire-fighters from extinguishing the fires. In Glen Dell's case, with insufficient height for recovery from an inadvertent spin; the Extra 300 impacted adjacent to the runway. A post impact fire consumed the aircraft and by the time the firefighters were in position to extinguish the fire, Dell had sustained major burns and died a few hours later after having been uplifted by helicopter to hospital.

In 2014, Eddie Andreini perished in his Stearman at Travis AFB in the USA after having impacted the runway during an inverted ribbon cut; first responders apparently took approximately four minutes to arrive on the scene of the accident. The family have apparently subsequently instituted legal claims for \$20M. In South Africa, an internal investigation by Airshow South Africa, concluded that in the case of fire and rescue responders:

- Most response teams at the smaller airfields are not aviation trained crews, the local municipalities do this as a once-in-a-year event, which on its own, poses a risk.
- They treat an aircraft accident as a vehicle accident.
- Their response in crowds are a first time experience for them; they mostly that deal with highway response situations.
- Fire-fighting equipment in some cases is 'marginal; there is no fire tender at the ready fitted with a foam gun and the fire fighters on 'cockpit standby' dressed in fire retardant suits.
- Response times of course remain contentious and the origin of the one minute response time to any accident site on-field which is generally accepted as the norm, has no scientific basis. Since the Secunda accident involving Glen Dell, the ARFF response times have been evaluated prior to the each show; most did it in 60 to 80 seconds and one at 28 seconds. However, off-field, all bets are off! Fortunately, or unfortunately, display accidents using a runway as the show line, most often occur on-field.

In essence, despite their enthusiasm and willingness to act as the ARFF for airshows, the local municipality general firefighting crew are simply not trained or adequately equipped for dealing with aircraft accidents and as such they will have to be trained as professional airshow first responders.

Most display pilots do not really consider the myriad of challenges facing first responders and firefighting crew and fly at airshows with the general understanding that first responders will arrive within the first few seconds of impact and be able to extract them safely. But sadly, most of the smaller airshows only have the minimum firefighting facilities and even if they respond immediately, the intensity of the fire may not always allow close enough proximity to the burning aircraft to enable the pilot to be extracted – particularly if the fire-fighters are not wearing fire immersion suits to enable them to wade through the flames.

One lesson that can be learned from some of the accidents in 2013 and 2014 is that firefighting crews MUST be on 'cockpit standby' at all times during a flying display since time is of absolute importance in preventing fires from starting or extinguishing existing fires. This of course implies that they are also all

wearing the appropriate firefighting personal protection. In an article in the ICAS quarterly, *Airshows*<sup>1</sup>, “*Fuel for Thought*”, significant questions were raised. Some of the questions were how many performers have:

- Installed a smoke oil switch (“Amanda Switch”) to cut off the smoke oil in the event of a crash?
- Installed a “G” switch to cut all electrical power in the event of a crash?
- Installed a fire suppression system?
- Wear full protection Nomex fire suit, crash helmet, gloves, boots and balaclava, ala motor racing drivers?
- Personally met with and briefed ARFF personnel on emergency egress?
- Provided an emergency egress plan for ARFF personnel.

Note. The full article is recommended reading for the entire airshow community at [www.airshows.aero](http://www.airshows.aero) under the sub-heading of Airshows Magazine, 3Q, 2014 as is the article “Air Show Emergency Response – Planning the Way Forward”, by Mike Berriochoa, in which is proposed that a rapid response vehicle, a pickup truck with basic firefighting equipment on board, be positioned at show centre. “Large fire trucks sometimes can’t get on scene fast enough. There is a difference between extinguishing a fire on a Stearman and a Boeing 737 and the response time has to be faster”.<sup>2</sup>

## 2014 STATISTICAL OVERVIEW

### Casualties

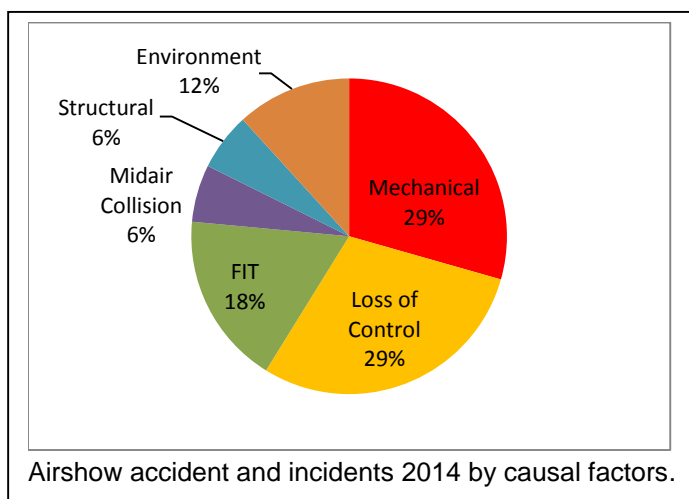
Although a total of 17 accidents and incidents were recorded, the lowest since 2003, the loss rate remained unacceptable with 12 casualties in which 10 pilots lost their lives, one passenger killed and one crew member was seriously injured. Fortunately no spectators were involved in the accident statistics for 2014, a rare achievement last achieved in 2012 which in itself, was a first in the history of airshows. As long as display pilots continue to offer passengers the opportunity to fly with during the display, we will continue to lose an additional life unnecessarily. There can never be a good reason to take a passenger on a low level display.

Fatalities remain untenable and unsustainable if the airshow community is to continue to exist without additional regulatory and insurance interventions, both of which could impose additional constraints on the ability to host air events. Sponsors are not generally amenable to supporting events in which fatalities occur; not good for branding at all!

### Causal Factors

For the fourth year in succession, Machine (mechanical failure) at 29% was the most significant contribution to airshow accidents and incidents, not the historical Flight-Into-Terrain (18%) and Loss of Control (29%). What is of concern is the number of mechanical failures within the vintage aircraft category, mainly engine failures. This contribution from MACHINE was thus high at 29% versus the historical average of 23%. Loss of Control was up from 21% to 29% while Flight-Into-Terrain was down from the historical average of 28% at 18%.

Not surprisingly, the primary contribution to Machine factors was closely tied into the increased number of vintage aircraft that were involved in airshow accidents; 41% of the accidents involved vintage aircraft, 80% of which were engine failures. Conclusion, mechanical failures on vintage category aircraft continued to contribute inordinately as the primary causal factor of accident statistics in 2014, a similar trend was evident in the previous year and is



<sup>1</sup> Airshows 3Q 2014, “Fuel for Thought”, Hugh Oldham.

<sup>2</sup> Airshows 3Q 2014, “Air Show Emergency Response – Planning the Way Forward”, Mike Berriochoa, Page 48.

certainly an indicator to monitor into the future. Safety officers could do well to increase attention to engine failures during vintage aircraft displays.

Very reassuring was the swing away from human error (FIT, LOC, and Mid-air Collision), down from 86% in 2010 to 53% in 2011, 42% in 2012, 52% in 2013 and 53% in 2014. Does this mean that the airshow community have become more sensitive to the threats and challenges and that pilot judgement and fine motor skills have improved? Does this imply that maintenance efforts, particularly on vintage aircraft engines have now regressed below standard or that the vintage aircraft engines are generally less reliable?

Flight-into-Terrain included two cases of inverted passes over the runway, one an inverted ribbon cut and one a car race. In both cases, from video footage, pitch attitude was not stable on the run-in and the final trajectories appeared to suddenly diverge. Neither accident investigations have yet been completed.

Three of the Loss-of-Control accidents originated from spins or tumbling manoeuvres, a concerning trend in which accidents from 'out of control' manoeuvres continues unabated each year. In many cases, the impact attitude of the aircraft approached the horizontal, implying the height budget for the manoeuvre was inadequate by several feet only, which leads one to believe that the energy loss is not consistent enough to provide the pilot with an absolute error margin. There is no doubt that the energy losses during gyroscopic tumbling manoeuvres is not an exact science and that a scientific study into energy loss during tumbling manoeuvres is required to quantify energy management and error budgets for such downline manoeuvres. A proposal will be submitted to a South African university aeronautical engineering faculty in 2015 to research the phenomenon of energy loss in downline tumbling manoeuvres.

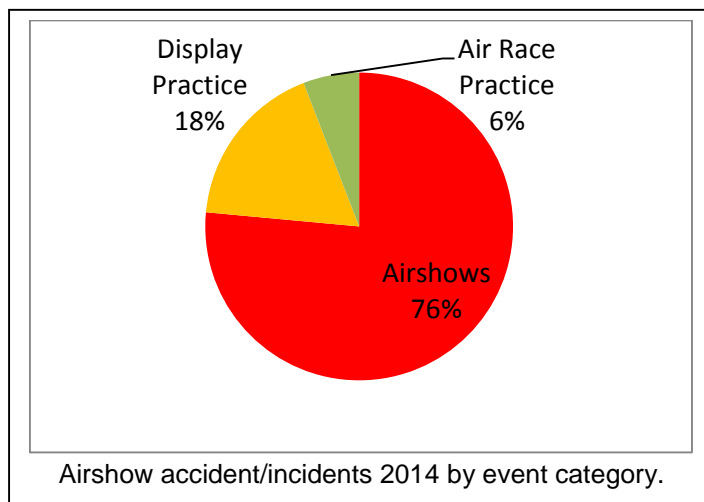
## A DISCUSSION ON ENERGY MANAGEMENT

To understand the essence of surviving low level display flying, it would be prudent to first define the scope and extent of controlling an aircraft safely during a manoeuvre, in the case of vertical manoeuvres. The pilot's tasks are typically:

- energy management,
- directional management of the display line, and
- management of the threat posed by the surface.

Threat and energy management must be coupled with sound judgement where the threat is constituted by the close proximity to the ground and is most critical due to the reduced decision making time. Considering the annual average loss rate of three aircraft to spins and tumbling manoeuvres, a prudent question is: "are all pilots sufficiently 'au fait' with the dynamics of tumbling manoeuvres and spins", not the actual entry and exit techniques, but the extent of energy losses that occur during such manoeuvres and the consequent height required to regenerate energy to effect a safe recovery.

A possible effort by all display flying communities worldwide would be for pilots in 2015 to revisit the theory of tumble manoeuvres and spins from the perspective of the physics involved. Most modern fighter pilots will have been exposed to the work of Colonel John Boyd (USAF), the father of energy management theory and also decision making via the OODA loop process. Is the term 'entropy'<sup>3</sup> understood and even considered by pilots involved in high energy 'stuff', not standard loops, straight rolls and barrel rolls, but those manoeuvres in which, arguably, the aircraft is 'out of control' during a segment of the manoeuvre and in which energy losses are not accurately predictable, viz. avalanche, Ruade and spinning, both erect and inverted. Manoeuvres in which the trajectory is a function of inertia, aerodynamics



<sup>3</sup> Stealing from the thermodynamics principles, entropy, the amount of energy unavailable to do work.

and torque and in which energy loss is not consistently repeatable and is often manifested by an aircraft impacting in a near horizontal attitude implying that an additional fifty feet could have saved a life.

Considering Boyd's work on energy management in fighter tactics, it is necessary for display pilots to understand that when flying manoeuvres close to the ground, they should not only be considering total energy and the classic conservation of energy theory in which in a perfect system, energy is a constant. No, they must subconsciously, consistently be considering the rate of change of energy with time viz. the rate of change of height with time and the rate of change of kinetic energy with time; the differential equating to the momentum of the aircraft ie mass x velocity.

A heretical question. The question of whether bringing competition aerobatics tumbling sequence minimum height limits into the airshow display box should possibly be reconsidered; the competition box lower limits are much higher than the zero foot waiver granted to airshow display pilots.

Ultimately, the combination of climb rate (a direct function of specific excess power) and the momentum at that specific moment in relation to the height above ground level, is the actual criteria mitigating for a safe recovery or not. Another output from energy manoeuvring theory is that of 'corner speed', the speed which maximum normal acceleration can be pulled without structural damage to the aircraft and the maximum turn rate can be generated while sustaining energy. How many pilots have under duress of 'ground rush' continued to pull maximum elevator up instead of unloading to achieve corner velocity before pulling for maximum pitch rate. A scientific research effort in an attempt to quantify the dynamics of tumbling manoeuvres will be conducted in 2015.

### Event Categorisation

Historically, 71% of accidents and incidents occur during actual displays versus practice. Although there was a significant regression in 2013 when the percentage of accidents occurring at actual air events increased by 14%, to 85%, in 2014 the ratio of actual airshows versus practice returned to 76%. This phenomenon can possibly best be explained by the fact that the pressure to perform during the actual event watched by spectators and at times under hostile atmospheric conditions, places additional stress on the pilot to 'press' the display to capability limits.

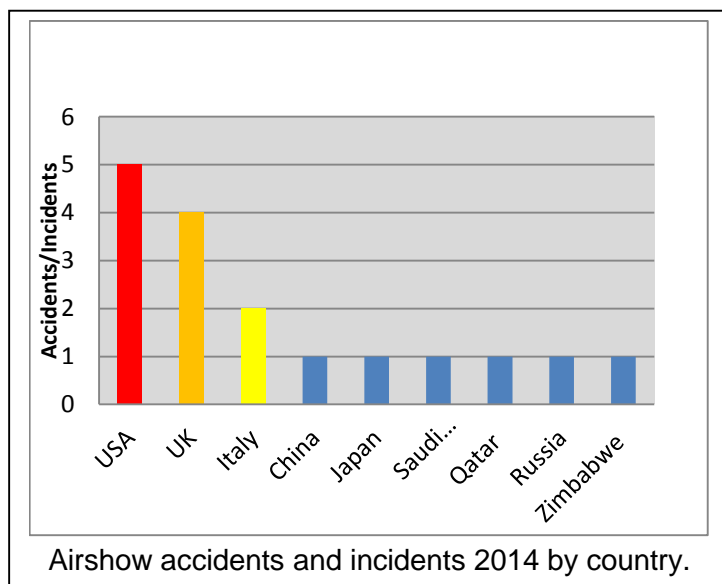
There are often cases in which the conditions during rehearsal are less than ideal and pilots then elect to postpone rehearsals until conditions improve. The problem is that on show day under less than ideal conditions, with the demands from the event organiser and pilot's wanting to meet their fee commitments, sometimes 'press' the performance and environmental boundaries under conditions for which they may not have practiced. The military adage of "fight like you train" is especially relevant; 'display like you practice' – anything else is pushing the error budget.

### Accidents by Country

17 accidents occurred in nine different countries; a significant improvement on the 34 airshow accidents and incidents of 2011, the 26 accidents of 2012 and the 21 accidents of 2013. The USA, by virtue of its significantly greater number of airshows annually, experienced five, accidents and incidents, the United Kingdom four Italy two, while China, Japan, Saudi Arabia, Qatar, Russia and Zimbabwe all suffered one accident. Sadly, there are no accurate statistics regarding flying hours flown in practice and during air events against which to make more statistical sense of the accident figures.

### Aircraft Categories

Bearing in mind the reduced participation of military aircraft at airshows worldwide and the increased number of vintage aircraft on the display circuit, the aircraft categorization essentially reflected the main participants worldwide with Vintage Aircraft involved in 41% of accidents,



followed by Jet Trainers at 23% and contrary to expectations, Sport Aero at 18%. The single largest change to the historical trends was that for the second time in close on 105 years, no fighters were involved in airshow accidents worldwide.

What was of concern however, was the fact that vintage aircraft, as was the case in 2011 through 2013, continued to make up the biggest contribution to aircraft types involved in the accidents and incidents, this being 30% greater than the historical norm. Since there has been a significant increase in vintage aircraft actively participating on airshow circuits worldwide, this is more than likely going to remain the trend in the future.

## 2014 ACCIDENT/INCIDENT OVERVIEW

### 1. 22 JANUARY 2014: BAE HAWK MK 65 (MANAMA, SAUDI ARABIA)

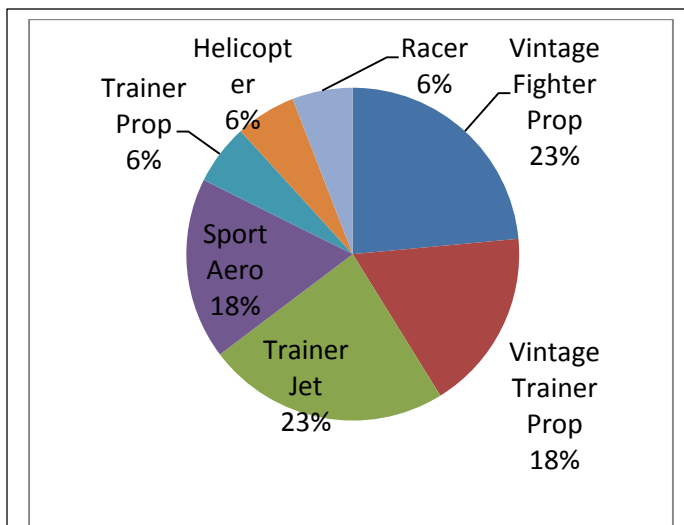
A pilot from the *Royal Saudi Air Force Hawks* aerobatic team had a narrow escape after his aircraft was hit by a large bird during a performance over Khobar which reportedly momentarily knocked him unconscious. A lucky escape? He regained consciousness and control of the aircraft just a few feet from the ground and was able to land the aircraft safely.<sup>4</sup>

### 2. 29 JANUARY 2014: (KAWASAKI T-4, MATUSHIMA, JAPAN)

Two of the Japan Air Self Defense Force aerobatic team's *Blue Impulse* that took off on a training sortie, collided during a four-ship practice flight. Both Kawasaki T-4's landed safely with no injuries to any of the three pilots. The leader's aircraft had damage to the nose, while the #2 lost half of its left horizontal stabilizer. No collateral damage was caused to other formation members from the debris.<sup>5</sup>

### 3. 07 MARCH 2014: EXTRA 300 LP, (AL KHOR, QATAR)

World champion stunt pilot Tamas Nadas died on the Al Khor runway during his second show of the day, sadly, in the presence of his family<sup>6</sup>. Hungarian, Nadas, popularly known as the "Schumacher of the Sky", was flying inverted a few feet above the runway during a race with a sports car in the early twilight when it impacted the ground. From video footage, the aircraft rolled inverted and for some



Airshow accidents and incidents 2014 by country.



Mid-air collisions remain one of the highest threats facing formation aerobatic teams. Nose of Lead impacted stabilizer of #2. (Source AFP)



#2 Managed to retain control of the aircraft and land with only one segment of the horizontal tail plane intact. (Source AFP)

<sup>4</sup> Aerobatic Display Teams News, "Saudi Hawks Bird Strike Almost Ended Fatal", downloaded 25 January 2014.

<sup>5</sup> Aerobatic Display Teams News, "Blue Impulse Mid-Air Collision", downloaded 29 January 2014.

<sup>6</sup> Gulf Times, "Schumacher of the Sky' Nadas Dies in Al Khor Crash", Anil John, dated 8 March 2014.

reason, a slightly divergent pilot induced oscillation developed as the pilot tried to achieve the ideal level height above the runway. As it approached the end of the runway, still inverted, it suddenly descended into the runway and then slid along the runway with pieces of the aircraft flying off; finally coming to a stop in the sand.

Rescue teams rushed to the scene of the accident but were unable to save the 44-year-old pilot, casting a pall of gloom on the high-octane world of aerobatics of which he had been a star for several years. The 'stunt' was part of the Qatar Racing Club organised *Qatar Mile* event which was billed as the "biggest speed festival of the region". The following day of the two-day event was cancelled following the tragedy. Could the low light conditions of the desert setting sun have contributed to the pilot struggling to find a visible horizon?

Nadas had previously stated in the media that he was a self-taught aerobat and that he sometimes feared for his life. "The single biggest challenge was that some of the stunts that I now perform were not taught to me by any instructor - they are all self-taught. I had to risk my life as I tried some of these challenging manoeuvres. There have been several occasions when I felt I was going straight down, but thankfully I would somehow regain control at the last minute", he said. Unfortunately, in this case, fate willed otherwise.

Comment by witness: "I was there during the first flight with my family and I am really sorry for what happened but I did not have a good impression about the safety the whole display was progressing, the display line (if there were any) was busted several times and more than one snap roll and spin was performed above the vertical of the public, so we felt unsafe and left the event."

#### **4. 04 MAY 2014: (BOEING STEARMAN, CALIFORNIA, USA)**

Airshow performer and ICAS member Eddie Andreini was involved in a fatal accident at the *Thunder Over Solano Air Show and Open House* at Travis Air Force Base in Fairfield. Friday 2 May was the practice day, with the public days on Saturday and Sunday, 3 and 4 May. The pilot flew two different flight demonstration aircraft at the event, a North American P-51 and the accident aircraft.

The accident occurred during a 'ribbon-cut' manoeuvre whereby a ribbon was suspended transversely across the runway between two poles held by ground crew personnel and situated about 20 feet above the runway. The planned sequence consisted of a total of three passes. The first two passes were to be conducted with the aircraft upright, and were not planned to contact the ribbon. The final pass was to be conducted inverted in which the aircraft would cut the ribbon with its vertical stabilizer.

The first two passes were uneventful, but on the third (inverted, ribbon-cut) pass, the aircraft was too high and the pilot did not cut the ribbon but instead went around for a fourth pass. He rolled the aircraft inverted after aligning with the runway but during the run-in, the trajectory suddenly changed downwards and the aircraft contacted the runway prior to reaching the ribbon, slid inverted between the ground crew personnel holding the poles, and came to a stop a few hundred feet beyond them.

Review of still and moving images indicated that fire became visible just before the aircraft came to a stop, and that the fire patterns were consistent with a pool fire of spilled fuel. Within about 50 seconds, the fire encompassed most of the right (downwind) side of the aircraft. USAF rescue and firefighting vehicles and personnel arrived at the aircraft approximately 4 minutes and twenty seconds after the accident and extinguished the fire.

The 47-gallon fuel tank was mounted in the centre section of the upper wing, just forward of the cockpit while the cockpit was enclosed by a canopy, which consisted of a metal frame and plastic transparencies with canopy opening requiring clearance above the canopy. The automated weather observation included wind from 240°/15 knots gusting to 21 and visibility 10 miles.<sup>7</sup>

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<sup>7</sup> NTSB Identification: WPR14FA182, downloaded 18 December 2014



With the pilot still trapped in the cockpit, local marshallsers, their handheld fire extinguishers expended, await the Fire Rescue services to extinguish the fire. (Photo Kathryn's Report)

Witnesses questioned the speed of the emergency response. "I ran over and saw it and there was no one there yet," a witness told KTVU, one gentleman actually had a fire extinguisher and he was trying to put it out himself, just him and two other people. Andreini was trapped in the cockpit of his vintage biplane as it burned. He died at the scene".

Even the show announcer commented that he looked unusually low, before his cockpit skidded along the ground, with white smoke, then black smoke billowing. The "*Thunder over Solano Airshow*" was immediately cancelled and the crowd of almost 100,000 asked to leave, without seeing the precision Thunderbirds, who were set to fly next.

Fellow pilots questioned if the gusting wind might have pushed the biplane

into the ground. There is little margin for error with the manoeuvre. "I'd like to think he could have survived if they had been able to get there faster," wondered another witness who was taking pictures about 100 yards from the crash. "The announcer was saying they've practiced for this, so everybody stay where you are, but everyone in the crowd was saying 'you've practiced for this, but where are you?' The Air Force said fire and paramedic crews were staged strategically off the runways, but wouldn't elaborate on whether they were delayed.

Two months after the accident, the cause of death announced by the Solano County Coroner fuelled the legal battle; the pilot's family was apparently planning to sue the federal government for \$20 million claiming the slow emergency response to the accident resulted in his death.

According to the *Sacramento Bee*<sup>8</sup> Andreini made radio calls after the crash saying he was ok but unable to get out of the aircraft. The video shows it took a little more than a minute for fire to spread from the right lower wing to the cockpit area and that's the crux of the family's case. The family's lawyer, told the *Bee* that Air Force regulations stipulate a crash response time of 60 seconds and it took about four minutes for fire trucks to arrive. None of the allegations have been proven in court.

#### 5. 16 MAY 2014: GRUMMAN F4U CORSAIR (GEORGIA, USA)

Pilot and owner of the F-4U "Korean War Hero", Jim Tobul, walked away safely after being trapped upside down in the cockpit for a time following a landing accident while practicing for the following day's *Good Neighbor Day Open House and Airshow* at DeKalb-Peachtree Airport. Landing with a quartering tailwind after making two overhead passes, the aircraft rolled off the paved runway at a fairly slow speed, flipped over and slid across the grass damaging the propeller and vertical stabilizer; it will take a major rebuild but the aircraft was expected to fly again. Take-off and landing with the canopy open is standard procedure on the Corsair



Jim Tobul walked away uninjured from a landing accident while practicing for the Good Neighbour Day Open House (Photo Kevin Porter)

<sup>8</sup> San Jose Mercury News, "Family of Eddie Andreini Seeks \$20M in Travis Air Force Base air show death", dated 17 July 2014.



which of course meant that his helmet got banged up but he was then able to egress the cockpit on his own.<sup>9</sup>

#### 6. 01 JUNE 2014: (YAKOLEV-55M, WISCONSIN, USA)

The pilot killed while performing aerial acrobatics at a *Stevens Point Airshow* was Bill Cowden. The Yak-55M was well into its sequence and had completed several descending aileron rolls before it rolled wings level and entered a near vertical climb. At the apex of the climb, the aircraft entered an inverted right hand spin from which the aircraft recovered.

Ground-based video footage showed that the aircraft completed 3-1/2 rotations in the inverted right hand spin from which the aircraft recovered, a momentary increase in aircraft pitch attitude achieved a positive deck angle of about 20° before the aircraft suddenly flicked over into left half roll with the pitch attitude dropping to a near vertical downline. The aircraft impacted terrain about 1,000 feet east of the runway. No mechanical anomalies that would have prevented normal operation were discovered during the accident investigation.<sup>10</sup> The airshow and airport was shut down after the incident, and attendees were sent home.

#### 7. 22 JUNE 2014: HISPANO HA-1112 M1L, HEADCORN, UK)

John Romain, restorer of the Hispano HA-1112 Buchon, pulled off a professional recovery from an engine failure due to a possible connecting rod failure during a display. The Spanish built variant of the Bf-109 developed a distinct and heavy vibration during an aerobatic sequence; this was followed seconds later by a heavy "thud" from the engine and then a complete loss of power. The aircraft was "zoom climbed" to convert excess airspeed to height and set up for a glide approach onto runway 10.

During the approach, it was noted that the elevator authority was low with the engine not producing any thrust which required a steeper glide descent to overcome this. In the event it was considered the runway was achievable and the undercarriage selected down before the engine seized (engine driven hydraulic pump failure).

The flaps were only lowered to 5° to give slight lift and minimal drag and the aircraft touched down just before the numbers and was brought to a stop within 3/4 of the runway. Although there was heavy oil smoke there was no fire. The airfield fire rescue services were on the scene quickly; an all-round professional display from pilot to first responders.<sup>11</sup>

#### 8. 29 JUNE 2014: SOPWITH TRIPLANE (BEDFORDSHIRE, UK)

Very unlucky and yet, very lucky at the same time! A minor misjudgement saw the Shuttleworth Collection's Sopwith Triplane come off second best in an altercation with a fence post on short final approach. Luckily, only minor damage and no damage to the pilot. The Sopwith Tri-plane (known as the Tripehound or Tripe) was first built at the end of 1916 and was powered by the Claret 9B rotary engine of 130 hp. Only two originals remain in the world, both now on static display, one in Russia and the other at the RAF Museum, London.

The aircraft marked as *Dixie II*, representing the original *Dixie*, serial N6290 of No. 8 Naval Squadron, was fortunately repairable.



Good show. Deadstick landing; engine oil emitted from the engine cowlings leaving a visible trail and covered the right side of the fuselage and tail. (Photo Nigel Paine)

<sup>9</sup> [www.myfoxatlanta.com](http://www.myfoxatlanta.com), "Plane Flips Over at PDK", posted 17 July 2014.

<sup>10</sup> NTSB Identification: CEN14FA266, downloaded 18 December 2014.

<sup>11</sup> [Forum.keypublishing.com](http://Forum.keypublishing.com), Duxford Diary 2014, downloaded 26 December 2014.

**9. 29 JUNE 2014: WACO UPF-7 BIPLANE, VIRGINIA, USA)**

While performing a routine act in the *Flying Circus Airshow*, a Waco UPF-7 biplane experienced a total loss of power and was forced to make an emergency landing in an adjacent field. However, the landing was too fast for the pilot to safely stop the aircraft before it impacted a tree grove at the edge of the field, totally destroying the aircraft. The pilot managed to escape and walk away with minor injuries only.

According to the pilot, the purpose of the flight was to fly in the opening act of a flying circus. After take-off, he performed five circuits in the pattern with other aircraft. During the fifth circuit, he "pushed up the power after the pass;" however, the engine did not respond. Then, there was a "puff of smoke" that came out from under the cowling and the engine lost power completely.

The pilot began to turn back toward the runway to perform an emergency landing but realized that the runway was too far away. Then, he verified that the throttle and mixture were "full forward," and performed a forced landing in an open field. During the landing roll, the aircraft impacted trees and came to rest in an upright position.<sup>12</sup>



Interaction between left wheel and fence post during final approach saw the Triplane flip onto its nose on landing. (Photos Aviation Safety Network)

**10. 05 JULY 2014: BAE HAWK (WADDINGTON, UK)**

The Red Arrows pilot, Flight Lieutenant James McMillan, was involved in bird strike incident during a display at the *Waddington International Air Show*. Red 6, the synchro leader of the team, hit the bird as the team were approaching the end of the display resulting in Red 6 missing the final flypast of the day. The aircraft landed safely with damage being limited to the nose of the Hawk and the spare aircraft being used the following day.<sup>13</sup>

**11. 31 JULY 2014: HAWKER SEA FURY (CORNWALL, UK)**

"Plane crashes at RNAS Culdrose air day in Cornwall" is how the media headlined this accident.<sup>14</sup> The pilot of the vintage Royal Navy Sea Fury from the Historic Flight at Yeovilton, Chris Gotke, walked away from the wreckage uninjured after crash landing on the runway at the *Royal Navy Culdrose Air Day* during the penultimate display of the day. The emergency services were there almost immediately.



The threat of bird strikes during airshow displays remains a real threat with no 'permanent' solution available. The criticality of a bird strike is amplified for formation aerobatic teams due to the close proximity of the aircraft. (Photo ITV News)

<sup>12</sup> NTSB Identification: ERA14LA319, downloaded 18 December 2014.

<sup>13</sup> ITV News, "Red Arrows Bird Strike High above the Tour", dated 6 July 2014.

<sup>14</sup> The Plymouth Herald, "Plane crashes at RNAS Culdrose air day in Cornwall", 31 July 2014.

Cosford Air Show air operations posted on Twitter: "RNHF Sea Fury T20 has completed a forced landing. Pilot OK. Runway currently blocked with aircraft resting on the fuselage". The last flying display was stopped after the crash.

Gotke declared an in-flight engine emergency during his display and requested an immediate landing but suffered further difficulties as the undercarriage extended asymmetrically with the left undercarriage down and the right 'dangling' loosely.

The aircraft ended up veering across the runway due to the asymmetric drag of the right undercarriage having collapsed, and came to a stop on the opposite side of the runway after the left undercarriage also folded up. It seemed the right leg did eventually come out, but too late but most importantly, was not locked down.

After coming to a stop, Gotke, uninjured, jumped out of the cockpit; an amazing silence prevailed, despite there being an estimated crowd of 30,000 people. Spectators described the landing it as "an amazing piece of emergency flying".

#### **12. 04 SEPTEMBER 2014: SAI MARCHETTI SF-260 GENET (HARARE, ZIMBABWE)**

Two pilots died when an Air Force of Zimbabwe (AFZ) SF-260 crashed after take-off at Charles Prince Airport in Harare. The aircraft, which was one of a four-ship, crashed into a nearby compound, killing the pilot and co-pilot. When the ZBC News arrived at the scene of the accident, AFZ senior officials were still trying to ascertain the cause of the accident with barricades being put in place while residents from the compound were driven out.

The ZBC News crew was denied access to film the aircraft wreckage and was ordered to vacate the area. People at the scene of the accident who spoke off camera, said four aircraft took off as part of the drills being done ahead of the airshow slated for Sunday. The airshow had attracted various partners from across the southern African region as the show was expected to attract thousands of people.<sup>15</sup>



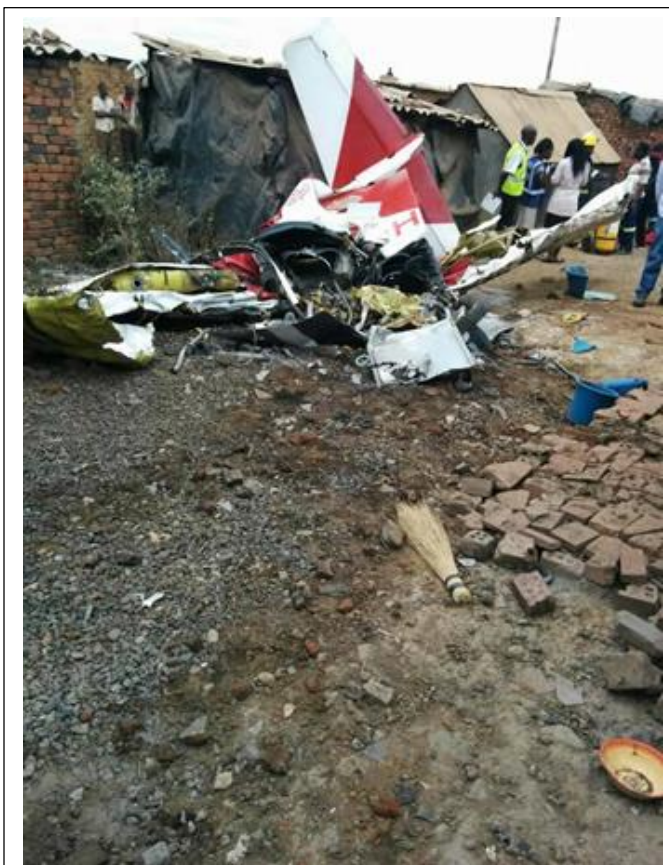
Unlocked right undercarriage asymmetric yawing moment on landing caused aircraft to slew off runway. (Photo: Ron Weldon)

#### **13. 05 SEPTEMBER 2014: MIL MI-8 HIP (GELENDZHIK, RUSSIA)**

An Mi-8 Hip helicopter crashed during the opening ceremony of an airshow in southern Russia. The chopper, belonging to the Russian "Panh Helicopters" company whose fleet of about 30 aircraft conducts scientific and aerial services, was opening the *Gidroavisalon 2014*, an international hydro airshow that attracted 180 Russian companies and 14 foreign delegations.

After a flag carrying flyby, the flag was lowered to the ground over the dispersal area and the helicopter reversed in flight but in the process, encountered vortex ring state which resulted in a heavy landing. The helicopter "bounced" on impact and broke into two pieces as the tail boom impacted the main

<sup>15</sup> NewsdzeZimbabwe, "Two Pilots Killed as Air Force Plane Crashes in Harare", 04 September 2014.



Cause of engine failure unknown at this stage. (Photo: Zimbabwe Latest News).



Without the availability of precious recovery height, 'Ring Vortex State' poses its own unique threat to helicopters during low level displays. (Photo: www.carscoops.com)

rotors and fell back to the ground, almost instantaneously exploding on impact. Two crewmembers were killed and one heavily injured with 90% burns.<sup>16</sup>

#### 14. 08 SEPTEMBER 2014: BACKOVICH GP-5 RACER (RENO, USA)

The *Reno Air Races* suffered the tragic loss of one its pilots, Lee Behel as the one-of-a-kind experimental amateur built GP-5 Air Racer was reported to have "broke up" at high speed and gone down during a qualifying run while competing in the Sport Class – a class he helped found in 1998 and was president of. His race aircraft, "Sweet Dreams" crashed at the north end of the race course away from the grandstands where the fatal crash occurred in 2011 that killed pilot Jimmy Leeward and ten spectators.

The sole GP-5 entered racing in 2010, originally powered by a small block Chevy and was later extensively upgraded and was reported to be producing in excess of some 625HP in recent flights. The rest of Monday's flying was cancelled for the remainder of the day but resumed on Tuesday, as planned.

Witnesses reported that the accident aircraft departed runway 26, turned south and manoeuvred to enter the race course. As the aircraft was observed passing outer Pylon 5, portions of the right wing separated from the wing structure. Subsequently, the aircraft began to roll to the right and impacted terrain; wreckage debris was scattered between race pylons 5 and 6. All major structural components of the aircraft were located within the approximate 4,000 foot long debris path.<sup>17</sup>

#### 15. 21 SEPTEMBER 2014: EXTREME 3000 (VENICE, ITALY)

'Black September' for the Italian display community as internationally renowned Italian display pilot, Francesco Fornabio, crashed and died at *Fly Venice* in his recently acquired Xtreme 3000. Fornabio, a member of the Italian national aerobatics team since 2002, specialized in the freestyle modality and won the Italian championship in 2014 in the unlimited category.

During the display, he pulled up into the vertical and executed a gyroscope manoeuvre which looked more like an 'avalanche' (was apparently a Ruade or 'mule kick') at the apex of the climb which developed into an out of control situation and instead of neutralizing the elevator, from the ground video it appears that the stick was kept fully aft which never allowed the wing to unstall. The aircraft was relatively intact after impacting nearly horizontally with the ground.

<sup>16</sup> De Telegraaf, Gruwelijke helicopter crash in Rusland, downloaded 22 December 2014.

<sup>17</sup> NTSB Identification: WPR14FA369, downloaded 18 December 2014.

The consequent spiral was continued to impact in a near horizontal attitude with a definite closing of the throttle heard just prior to impact. Questions were raised as to whether this was possibly the natural human reaction to a rapidly shrinking downline so close to the ground; “ground rush” is what could have prevented stall recovery.<sup>18</sup>

Questions were also raised regarding the prevailing weather conditions; the day was quite hazy and many aircraft couldn't reach Venice Lido airfield because of the low visibility, plus the airfield is adjacent to the ocean with only a beach dividing the airfield from it; there was no wind and part of his show was almost above the calm water surface, haze, flat sea, low cloud ceiling; peripheral cues were adversely affected.



The near horizontal attitude at impact kept the aircraft intact; fortunately, no post impact fire. (Photo: [www.documentingreality.com](http://www.documentingreality.com))

#### 16. 28 SEPTEMBER 2014: PITTS MODEL 12 (SIENA, ITALY)

One week after Francesco Fornabio, another aerobatic pilot, Filippo Roncucci, crashed in his Pitts at Mensanello, a small local airfield while performing during an annual Fly-in at Filippo's airfield that both pilots had started a few years previously. Sadly, a Russian female passenger perished in the accident once again raising the question of passenger carriage during low level demonstrations. First information reported an inverted flat spin.

Comment from a witness: “How would it affect spectator value if the vertical manoeuvres were done upwards? It seems to me spinning is a major contributor to display fatalities. Also high G manoeuvres towards the ground. Would spectators be less impressed if you do snap rolls going up to spinning down?”

He continued: “Sad loss of another skilled pilot. The irony is that these new tumbling manoeuvres that are in fashion at the moment are lost on the general public and on most of us. The public can't even tell the difference between a snap roll and a normal roll and they couldn't care if it is done facing at the ground or not.

#### 17. 16 NOVEMBER 2014: AERMACCHI MB-339 (ZHUHAI, CHINA)

"Al Fursan" (The Knights), the United Arab Emirates Air Force aerobatic display team, is the newest military formation aerobatic team on the display circuit. In July 2010, eight UAE Air Force fighter pilots began an aerobatic formation training course under the supervision of “Frecce Tricolori” pilots at Rivolto Air Base in Italy and made their first public aerobatic demonstration on 13 November 2011 during the first day of the Dubai Air Show. The Al Fursan experienced an incident when #7 overran the runway on landing during the last day of 10<sup>th</sup> China International Aviation and Aerospace Exhibition at Zhuhai Airshow in China after experiencing brake failure. The pilot, Hamad Alkindi exited the cockpit safely without injuries.



Brake failure during a formation landing of 'Al Fursan' as #7 overruns the runway on completion of the display. (Photo: [www.dfic.cn](http://www.dfic.cn))

<sup>18</sup> La Stampa Italia, Aereo cade al Lido di Venezia, muore pilota”, dated 22 September 2014.

## CONCLUSION

2014 confirmed a continued downward trend in the absolute number of airshow accidents and incidents worldwide with the highlight being that there were no injuries to spectators or the public. There seems to be broad consensus that the reduction is due, at least in part, to aggressive, ongoing efforts to focus the industry's attention on safety concerns and the necessity to maintain that attention and pressure. However, in striving for excellence, the loss of eleven aircrew lives, continued the trend of every other year's loss rate of an average of sixteen over the past five years, which is untenable and implies that we are still not getting it right. Furthermore, **THERE CAN NEVER BE A REASON TO TAKE A PASSENGER ON A LOW LEVEL DISPLAY.**

Despite a significant reduction in the number of accidents, this was offset by the continued inordinate number of engine mechanical failures. Of the ten fatal accidents, 17% of them resulted from intentional spin/tumble/gyroscopic manoeuvres which went wrong and from which there was insufficient height to recover; it would be prudent for display pilots to remember the hazards of performing spin/tumble/gyroscopic manoeuvres with little margin for small variations that could lead to extra height loss during recovery. The energy loss in a tumble/spin is a variable that must be investigated scientifically in an effort to provide quantitative planning information to the display pilot.

In the high ratio accidents at airshows versus practice, is it possible that pilots aren't practicing as much they should be? Yes, there is the pressure of the crowd and the demands of the airshow environment, but we must also consider the possibility that pilots are simply not practicing sufficiently. For the warbird operators, this is very much a possibility. Another possibility is the preparation where pilots practice at higher altitudes, giving them a cushion if/when things go wrong. These are all aspects that must be considered if the international community intends to continue to drive down the annual accident rate.

Is the standpoint that we can only control those accidents in which pilot skill and judgement is controllable, valid? ie flight into terrain, loss of control, mid-air collisions, etc and accept that mechanical failure as part and parcel of the risk? If yes, then we need to delve a little deeper and focus on quick wins within the human contributions of flight into terrain, loss of control and midair collisions.

The issue of first responder response to the firefighting challenges imposed by burning aircraft **MUST** be addressed as a matter of urgency, including firefighting equipment, personal protection suits and 'cockpit readiness' in anticipation of immediate response.

Dealing with the aforementioned issues holds the potential for 'quick wins' well within the capabilities of airshow organisers, safety officers and display pilots which can ultimately contribute to driving an agenda for zero airshow accidents per annum. Safe airshows 2015!