

Airshow Incident Accident Review 2019

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This report does not seek to pass judgement on airshow accidents other than reporting on information in the public domain in an effort to identify and alert the airshow community worldwide, to accident trends in airshow safety. What can be concluded was that airshow 'guardian angels' once again worked overtime in 2019 and did a splendid job of restricting the number of airshow accidents at air events worldwide.

INTRODUCTION

'Black 2010' with its 41 airshow accidents/incidents is still in the minds of those deeply involved in airshow safety worldwide when consensus was reached between ICAS EAC and ASSA that the accident/incident rate had to be arrested - clearly, by 2019, the objective has not been fully achieved. From 2011 to 2014, regulators and the airshow community were patting themselves on the back with statistical evidence of decline being arrested clearly evident. The concern was always "were we seeing an actual definite decrease worldwide accruing from the contributions of the display pilots, safety officers, air bosses, airshow organisers and spectators, or was it just a statistical spike?"

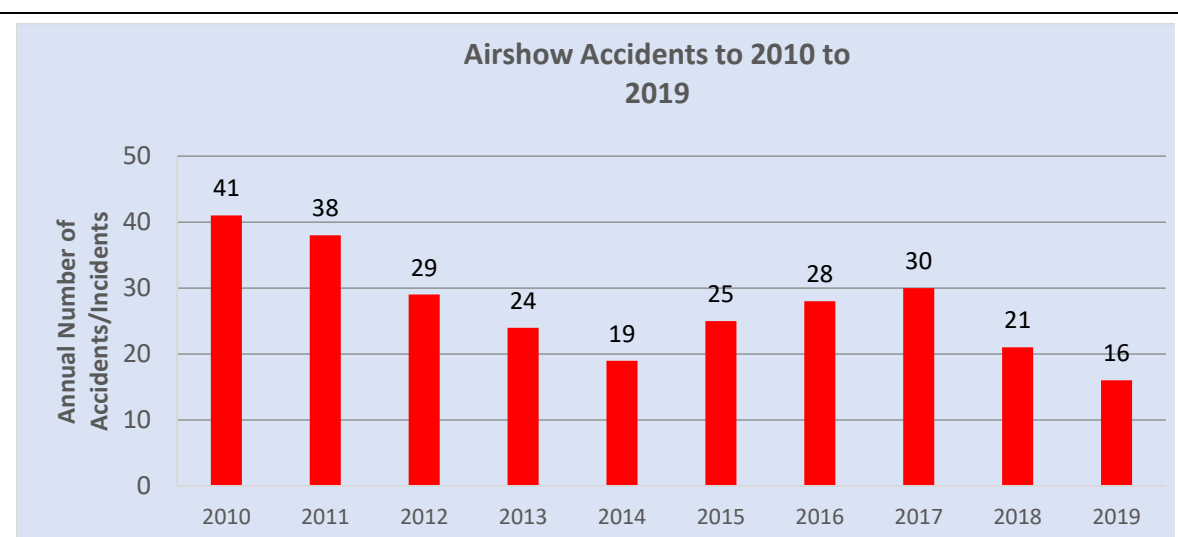
From 2015 it became apparent that it was just a statistical spike and we saw a steady increase in airshow accidents again until 2017 but since then, a downward trend is once again evident and those monitoring the statistics are once again questioning whether we have a definite change in airshow discipline or is it just a statistical spike? 2020 will certainly provide the answers.

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 111 years of airshows?

2019 SIGNIFICANT ACHIEVEMENT

The most significant indicator in 2019 was the lowest number of airshow fatalities ever, only ten versus the historical average of twenty-one. In turn, the lowest number of pilots lost their lives, only five, versus the annual average of 13. What drives this performance?

Opinions differ but it is thought that a greater awareness of risk and risk management by pilots, air bosses and event organisers have given new impetus to 'risk aversion', which in turn has induced greater oversight by regulators, new regulations and control mechanisms, the creation of the 'Fair System', improving the Just Culture mentality, a greater understanding of the regulations, accreditation of FDD's and documentation, and a greater concentration by pilots on display areas, heights and separation distances.



Statistical analysis of airshow accidents over the past 10 years shows a year on year average of 27 accidents per annum but with a significant downward trend since 2018. Is the downward trend an indication of airshow discipline or just a statistical spike? There does not appear to be an ability to reduce the accidents/incidents per annum to zero!

Of significance was not only the relatively small number of 16 accidents and incidents, (historical average past twenty years is 27 accidents/incidents per annum) but no members of the public were killed although one member of the public was injured at Aero India when the Surya Kiran BAe Hawk 132 impacted the area adjacent to the airfield.

2019 STATISTICAL OVERVIEW

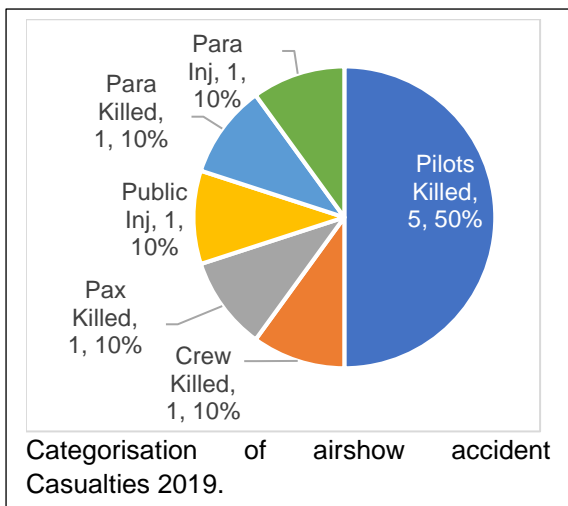
Casualties

A total of 16 accidents and incidents were recorded which resulted in an unacceptable 10 casualties in which 5 pilots lost their lives and 1 pilot was injured. This was well below the historical average of 13 pilots killed per annum.

The death of a passenger in a low-level display in this day and age in which the carriage of passengers is actually prohibited, was of concern – a pilot that takes a passenger on a low-level display flight should understand that loss of life could see the pilot prosecuted by family members? Claims against the pilot’s estate is possible should the pilot also perish in the accident. There can never be a good reason to fly a passenger on a low-level display!!!!!!!!!!!!!!

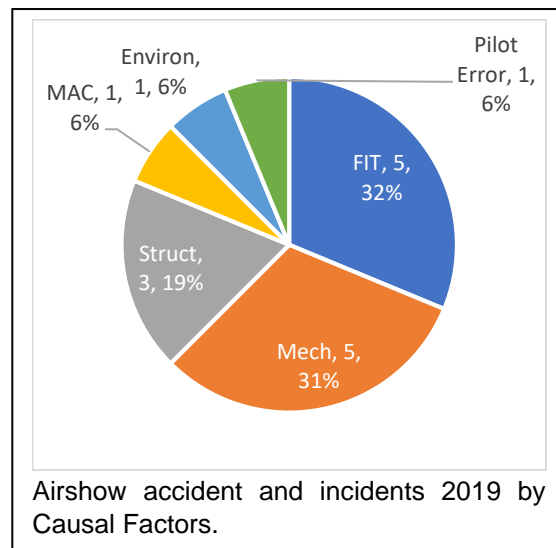
The loss of lives from skydivers continues annually, one fatal and one serious injury occurred. Parachutists have been an integral part of airshows from the beginning of airshows and have also paid the ultimate price during public demonstrations of their skills.

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



Causal Factors

5 ‘Flight-Into-Terrain’ accidents (32%) occurred which was higher than the historical average of 26%. However, no Loss-of-Control accidents were recorded versus the historical average of 18%. The reduction in ‘up and away’ loss of control accidents was heartening and reversed the trend of ‘out of control’ manoeuvres which have continued unabated throughout the history of airshow accidents.



Mechanical failure once again made it’s unwelcome contribution of 31%, this against a historical 17% contribution and was mainly attributable to engine failures/fires and a brake failure on a *Patrouille de France* Alpha Jet.

The unique occurrence of three structural failures was concerning. Two cases, both on an F-16, both with the same pilot, one in which the trailing-edge of the right hand stabilator composite structure delaminated and in another case, lost an armament access panel. A MiG-35D also managed to lose a panel on the left wing while demonstrating at MAKs 2019 – fortunately all safely recovered.

A positive feature was that there were no accidents accruing from tumbling gyroscopic manoeuvres for the third year in succession. Could it be that display pilots now understand that tumbling manoeuvre trajectories and dynamics are not an exact science and that energy management, the non-availability of energy (entropy) and error budgets for such downline manoeuvres must be more optimistic?

Could it be that display pilots that include high energy tumbling manoeuvres in their routine, now understand the inconsistent and unpredictable nature of energy loss and the importance of maintaining situational awareness regarding the aircraft’s trajectory and to terminate the manoeuvre at the first sign of the aircraft’s trajectory transitioning to a

downward vector - gyroscopic manoeuvres on the downline at low heights at airshows are not for amateurs or for that matter, the professionals either!

The midair collision from mirror formation for the third time in three years indicates that some display pilots do not understand that their aircraft may not roll around the inertial axis but around the aerodynamic axis and any burying of the nose without adequate separation, could result in a midair collision. Most importantly, the lateral offset between the two aircraft must be maintained at all times to guarantee free manoeuvring space if required – transgressing this fundamental requirement, will increase the probability of a midair collision.

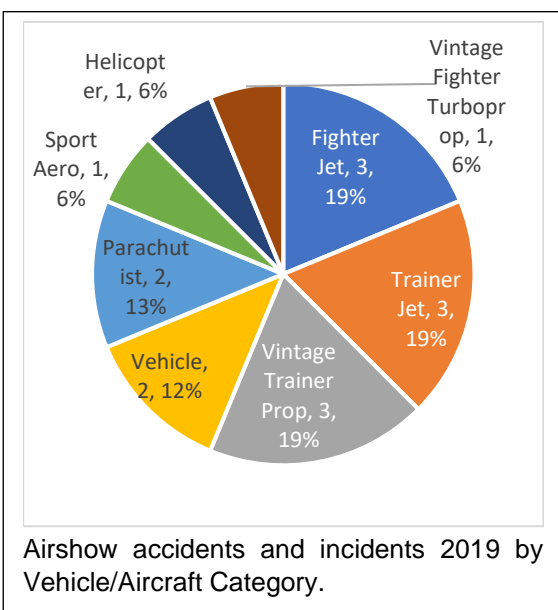
Event Categorisation

Historically, 76% of airshow accidents and incidents occurred during actual displays versus 24% during practice; 2019 saw similar occurrence rates with actual airshows and air events at 80% versus 20% during practice.

Could this be that the military adage of “fight like you train” is not applied by display pilots. Display like you practice’ – anything else is pushing the error budget.

Aircraft Categories

The trend of vintage aircraft over the past five years making the greater contribution to airshow accidents, was resisted. Three fighter jets (19%), three jet trainers (19%) and three vintage trainer propeller (19%) contributed equally. Skewing the distribution pattern was two ground vehicle accidents, a Jet Truck fire and then of course the Aero India Car Park which caught alight and in the process, burnt out approximately 300 vehicles.



Accidents by Country

16 accidents occurred in 12 different countries. 4 Accidents and incidents occurred in the USA, 2 in India, and 1 each in Austria, Canada, France, Guatemala, Honduras, Indonesia, Poland, Russia, South Africa and the UK. 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.

It bears mentioning that the USA hosts approximately 350 aerial events annually, followed by the UK with approximately 120, Europe 100, Australia/New Zealand 40, South America 40, Africa 30 and India/China 30.

How Safe were Airshows in 2019?

This report considers airshow safety holistically, not only aircraft accidents, but also incidents directly involving the professional execution of an aerial event. Any incident that jeopardises the safety of lives, aircraft, property, or adversely affects the reputational damage of the aerial event, is included.

There is a school of thought that only actual aircraft accidents/fatalities should be considered in the safety analysis, but that would not provide a realistic measure of system safety at airshows, since an airshow is not just an aerial display by some aircraft, but rather a system of systems which includes aircraft, display pilots, safety officers, air bosses, vendors and most importantly, fare paying spectators. If an airshow safety plan does not include oversight across the complete spectrum of airshow actors, the probability of losses is compounded.

Why is this important? The livelihood of several thousands of passionate aviation enthusiasts and charity organisations worldwide are affected and any reputational damage or additional regulatory interference that could drive costs up, could prove critical to their sustainability.

Only 16 accidents and incidents worldwide during 2019 compared to the twenty-year historical average of 27 accidents/incidents per year. Could this be an indication that the airshow community worldwide have learnt from the mistakes of the past and that we have ingrained standard operating procedures and regulations to keep airshows safe?

Unfortunately, precise statistics are unavailable and at best an educated guess is used. Assuming the historical approximation of 700 aerial events per annum worldwide, (EAC 2019) there was a significant reduction in airshow accidents and incidents in 2019 compared with the last twenty years. Assuming

a minimum of 700 aerial events, airshows, flypasts, fly-ins, air races occur annually:

- 30 separate display items presented at each = 21,000 single items. Assuming each display item requires at least:
 - 3 practices.
 - 1 validation.
 - 1 display.
- Therefore 5 separate display items x 21,000 = 105,000 displays.
- Adjustment for formations of 4 x 105,000 = 420,000 display items worldwide.
- 2019 = 16 airshow accidents/incidents during airshows and practice. Therefore:
 - Accident/incident rate 0.000038 per single event.
 - 10 Casualties = an incredulous 0.000024 rate per single event.
 - 8 Fatalities rate approximately 0.000019 per sortie or 0.19 fatalities per 10,000 display items.

Statistically, therefore, considering the hazardous nature of low-level manoeuvring, airshow safety in 2019 was relatively safe.

ACCIDENT/INCIDENT OVERVIEW 2019

1. 04 FEBRUARY 2019: STAUDACHER S600 (ST WOLFGANG, AUSTRIA)

Divine intervention had to be called upon very early in the 2019 airshow season as the Staudacher S600 clipped its left wing into the Wolfgangsee during a descending left hand, low-level positioning turn. The left-wing tip slewed the Staudacher to the left as the aircraft 'bounced' off the water surface several times before pitching nose-down into the lake. Depth perception and the lack of peripheral cues over flat, calm water surfaces test the physiological capabilities of the human.

However, engine failure was reported as the cause by the pilot who was able to escape from the cockpit independently, unhurt. He waited on the wing for his rescue by St Gilgen Water Rescue, a lifeboat positioned on-site for emergency standby, could intervene immediately.¹ The value of 'cockpit readiness' by first responders once again proved its worth in saving an airshow actor.

2. 19 FEBRUARY 2019: BAE HAWK MK 132 (BENGALURU, INDIA)

Efforts by India for the *Aero India* to recognised as one of the world's premier aerospace events, were jeopardised by two accidents – a midair collision between *Surya Kiran* and a fire in the public parking space allocated to visiting spectators.

Two Hawks of the Indian Air Force's nine-ship *Surya Kiran Aerobatics Team* collided at the Yelahanka Airbase while rehearsing for the five-day *Aero India* show.

The midair collision occurred during the 'Calypso Pass', essentially 'mirror' formation, when for unknown reasons, the upper Hawk, inverted and canopy-to-canopy with the lower and without adequate lateral separation, struck vertical stabiliser to vertical stabilizer and then the tailplane/wing area of Lead causing both aircraft to break up in flight. Smoke billowed from the site and burning debris was scattered all over the airbase.

The two pilots in the Lead aircraft, Wing Commander Vijay Shelke and Sqn. Ldr.



Without lateral separation, the wingman descended onto Lead, tail-to-tail, with catastrophic consequences.



Rows of burnt out cars greeted members of the public on returning to the Car Park during the *Aero India* airshow. (Photo: India Today)

¹ ASN Wikibase Occurrence # 221525, Staudacher S600, 4 February 2019.

Tejeshwar Singh, managed to eject safely. Commander Sahil Gandhi, a former Sukhoi-30 pilot, who flew as *Surya Kiran 7*, died when his jet crashed just outside Yelahanka Air Force Station. Police said a civilian, adjacent to the airfield, was also injured by the Hawk impacting off field.²

3. 23 FEBRUARY 2019: CAR PARK FIRE (BENGALURU, INDIA)

Worst case scenario at an airshow; a fatal accident supplemented by a fire in the public vehicle park destroying 300 cars marred the international airshow, not only for the aviation community, but the general public in attendance. The most likely cause was a dry grass fire aided by heavy winds. It is not clear whether or not fire services were on standby at the vehicle park - maybe a very good idea to provide fire protection services at airshow car parks?³

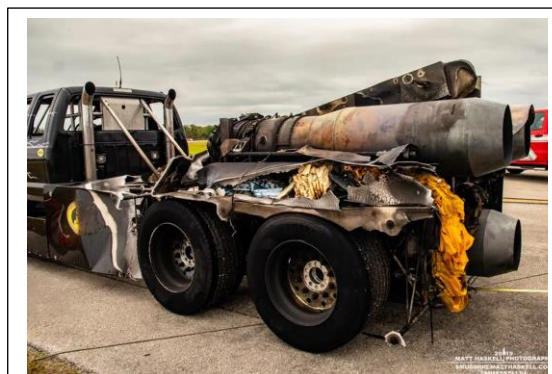
4. 9 MARCH 2019: PARACHUTIST (HONDURAS)

An experienced army paratrooper plunged to his death in front of horrified spectators when his parachute failed to open while taking part in a skydiving demonstration as part of an aerial spectacle near the remote town of La Union. Lt. Tito Olivera Gonzalez, a member of the Honduran Army's elite Special Forces, plummeted towards the ground when his parachute failed to open after jumping from a helicopter at 1 524 metres.

Instead of landing on a soccer pitch where spectators were waiting for the team to land, he impacted the mountainside near the town. Emergency services raced to the scene but Tito was dead by the time they arrived.⁴

5. 9 MARCH 2019. NORTH AMERICAN T-28 TROJAN (ESQUINTLA, GUATEMALA)

The initiative by event organisers to increase spectator appeal and revenue, has resulted in increased participation of aerial events at 'non-airshows'. The immediate question though is, what level of safety oversight prevails, no 'show box', no regulatory overseer? Is it possible that the drive to impress in most cases, the 'illiterate airshow masses', brings out the drive for recognition and adulation? How else could one describe the sequence of events in which spectators came to watch motor car performances at the *National Motor Sports Championship* at



Extensive damage to the tailpipe section of the Jet Car was evident following an onboard fire during the demonstration. (Photo credit:

Escuintla Volcanes Racetrack, and in the process, witnessed a fatal aircraft accident?

The event organizers decided to diversify the motoring event with an airshow that ended with the death of two people, the pilot and a passenger. A passenger on a low-level airshow? This begs the question, where has the pilot been all these years during which the carriage of passengers on airshow flights are prohibited?

The T-28 Trojan was doing low fly pasts directly towards the motor racing pits at an angular offset of approximately 45° which brought the spectator stand directly onto the low-level flight path.

Rodrigo Ibarguen pulled out from a wingover for the second pass at approximately 20 ft agl over the motor cars in the pits, and after missing the spectator stand by mere feet, the aircraft impacted a tree, after which it crashed onto the road behind the enclosure, killing Ibarguen and his passenger, aviation mechanic Pablo Guillain.⁵

6. 17 MARCH 2019: JET TRUCK (TITUSVILLE, USA)

A jet truck fitted with extra engines to create a jet-style roar, caught fire during a demonstration at the *Space Coast Warbird Air Show* but was quickly doused by fire personnel at the scene, temporarily halting the show. No one was injured.

It wasn't the first brush with a fire at the air show. In April 2018, the climax of the show's 'Tora! Tora! Tora!' event, set off a grass fire during the re-enactment of the Pearl Harbour bombing which sparked a grass fire that quickly spread to a nearby cache of fireworks, which

² ASN Wikibase Occurrence # 221978, BAe Hawk Mk 132, 19 February 2019.

³ Sunday Times, Times Live, *Fire at Government-run Airshow in India Destroys Hundreds of Cars*, 23 February 2019.

⁴ The UK News, *Paratrooper Falls to his Death When Chute Fails to Open*, 10 March 2019.

⁵ ASN Wikibase Occurrence # 222813, North American T-28B Trojan, 10 March 2019.

exploded, fortunately a distance from the crowd.⁶

7. 15 JUNE 2019: YAKOLEV YAK-52 (PLOCK, POLAND)

A German aerobatic pilot and former Lufthansa pilot, died during the *7th Air Picnic* when the Yak-52 he was demonstrating, impacted the Vistula River. The Yak entered an eight-turn right-hand spin but was unfortunately too low to recover and impacted the water in a 30° nose-down attitude, killing the pilot.⁷

Video footage shows various pro-spin control applications of right rudder, elevator trailing edge up and left aileron at times. The control inputs appear to be maintained until just one rotation short of impact; the aircraft stopped the right-hand rotation split seconds before impact and started to rotate to the left..

Was 'ground rush' a possible contributory cause of the stick being pulled back to avoid impact and the aileron to roll the wings level? The aircraft impacted in approximately 8 metres of water.

8. 21 JULY 2019: LOCKHEED MARTIN F-16C FIGHTING FALCON (FAIRFORD, UK)

The first display aircraft of the Royal International Air Tattoo (RIAT) Sunday programme, was the USAF *F-16 Viper Demonstration Team* which was cut short mid routine after an emergency call from Maj. Garret "Toro" Schmitz.

Concerned by flight control system issues and airframe vibration, Schmitz suspected that the arrestor hook may have extended and called a halt to the demonstration, spiral climbed to conduct an in-flight investigation before converting to a low speed flyby followed by a full stop landing. Investigation revealed delamination of the trailing edge of the right hand stabilator.⁸

Fatigue life monitoring of composite structures, remains obscure. Several cases of composites delamination on high performance aerobatic aircraft have resulted in catastrophic failure. The August 2015 accident of the Giles G-202 is a classic example; the Giles G-202 suffered complete structural failure of the rear fuselage just forward of the junction of the horizontal and vertical tail planes. A few weeks later, an MX-2 lost a wing and an engine leading to the pilot bailing out at 500 ft agl.

The prudent question that begs answers from composite designs. Have we managed to fully understand the composite fatigue load

spectrum on high performance aerobatic aircraft and the in-service integrity testing of



The delaminated composite on the right hand stabilator caused the pilot to terminate the display and land asap. (FLYHIGH.NEWS, Elwyn R)

composites? The forces on the airframe and during some manoeuvres are extreme to say the least.

What should be of major concern to composite sport plane display pilots is that material sciences do not yet have a full understanding of the composite fatigue loadings. The testing of such structures remains a 'black art' despite infra-red thermography, ultrasonics and radiography – the behaviour and inspection of composites needs to be developed.

9. 25 JULY 2019: DASSAULT E-146 ALPHA JET, PATROUILLE DE FRANCE, (PERPIGNAN, FRANCE)

A Dassault-Dornier Alpha Jet (Athos 2), of *Patrouille de France*, overran Runway 33 at



Alpha Jet (Athos 2) rolled off the end of the runway after losing control due to a brake technical malfunction which saw the pilot having to eject. (Photo credit: Nicolas Cassagne)

⁶ J.D. Gallop, *Jet truck bursts into flames at Titusville air show; no injuries*, Florida Today, 17 March 2019.

⁷ ASN Wikibase Occurrence # 226177, Yakolev Yak-52, SP-YDD, 15 June 2019

⁸ ASN Wikibase Occurrence # 227669, General Dynamics F-16C Fighting Falcon, 21 July 2019.

the Aéroport Internationale Perpignan-Rivesaltes, a small international airport where they were scheduled to participate in the *St Cyprien Air Festival*.

During undercarriage extension Athos 2 confirmed with ATC that due to a technical malfunction, no braking would be available. With loss of braking capacity, the Alpha Jet overran the runway but not before Capt. Jean-Philippe called upon the 'zero/zero capability of the ejection seat to extract him from the cockpit before the jet entered the overrun. The Alpha Jet came to a stop on an embankment close to D117 Peyrestortes Road, which bordered the runway while Jean-Phillipe survived with a dislocation of the shoulder and lumbar trauma.⁹

All their planned displays were suspended pending investigation into the cause of the accident. The pilotless Alpha Jet sparked a small fire on grass verges on the roadside which were quickly doused by the first responders.

10. 02 AUGUST 2019: LOCKHEED MARTIN F-16 FIGHTING FALCON, VIPER DEMO TEAM, (MICHIGAN, USA)



The F-16 pulls vapor as the missing panel is visible. (Photo: Tom Demerly/-TheAviationist.com)



Eleven days after an incident at RIAT when an F-16 horizontal stabilizer delaminated, another F-16 flown by the *Viper Demo Team*, the M61A1 six-barrel, 20mm Gatling gun access panel separated in flight during during a practice session for the *2019 Thunder Over Michigan Airshow* at Willow Run Airport in Romulus.

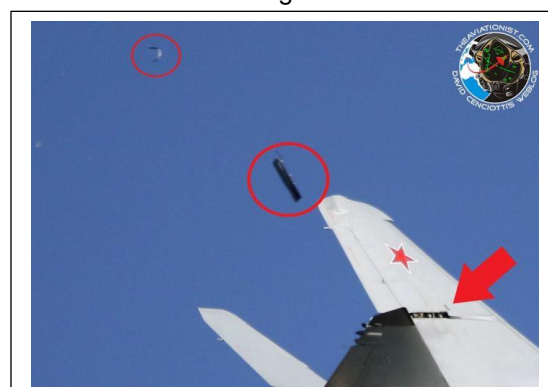
The panel separated from the Viper as it executed a high "G" turn when the access panel latch failed. Following the separation of the panel from the F-16, the demonstration practice concluded normally and Maj. Schmitz joined up with a P-51 Mustang in formation to complete the Heritage Flight demonstration before landing.

After the panel detached, emergency vehicles were seen briefly driving onto the airfield adjacent the main runway at Willow Run, but quickly returned to their ready parking positions when the incident was not declared an emergency.

The F-16 Demo Team completed their demonstration the next day using the second aircraft they brought to *Thunder Over Michigan*.¹⁰

11. 29 AUGUST 2019: MIKOYAN MiG 35D (MOSCOW, RUSSIA)

A new MiG-35D two-seat, "generation 4++" fighter lost a wing panel from its left wing after take-off during a flight demonstration at the MAKS Aviasalon 2019 airshow at Zhukovsky Air Base; the MiG-35 continued with its flight demonstration and fortunately landed without incident despite the missing components. The prudent question of course, is why would the pilot continue the display with known structural damage?



The third structural incident of the 2019 airshow season as a panel separated from the left wing of the new MiG-35D shortly after take-off. (Tom Demerly, The Aviationist)

⁹ Patrouille de France (@PAFofficiel) July 26, 2019.

¹⁰ Tom Demerly, *F-16 Loses Gun Panel During Viper Demo Team's Display Practice at Thunder Over Michigan Airshow*, 4 August 2019.

The missing wing panel and other components that separated from the aircraft landed in a field not far from the photographer's platform.¹¹

12. 31 AUGUST 2019: NANCHANG CJ-6 (ALBERTA, CANADA)

The pilot of a Chinese-built vintage military training aircraft crashed while performing aerobatic manoeuvres during the *Smith-Hondo Fall Fair and Rodeo* in Smith. The police stated that two small planes were performing for the *Smith Fall Fair* when one of the planes disappeared. It was found an hour later east of Smith, Edmonton; the pilot had succumbed to his injuries. An online poster for the Fair listed the Barry Pendrak Airshow among Saturday's attractions.¹²

13. 1 SEPTEMBER 2019: PARACHUTIST (PRETORIA, SOUTH AFRICA)

A 4x4 Outdoor Expo held at the Zwartkops Racetrack included an aerial display and parachutists but ended catastrophically for a South African Special Forces parachutist when he impacted the track after losing control of the parachute from approximately 30 ft agl. He was seriously injured and hospitalised.

14. 09 OCTOBER 2019: MIL Mi-35P (MANADO, INDONESIA)

The military parade dedicated to the 74th Anniversary of the Formation of the National Armed Forces in Indonesia was marked by an unexpected incident. Mi-35P "flying chariot" combat helicopter demonstrated its destructive power in unusual ways. Flying in time and in formation at approximately 25 ft agl with the advancing marching troops, the rotor downwash ravaged the posters and awnings attached to the main stage housing the dignitaries and spectator stand as the parade passed by the dignitary's stand.¹³

15. 13 OCTOBER 2019: CF-114 TUTOR, (ATLANTA, USA)

Snowbird 5, Capt Kevin Domon-Grenier of the Snowbird Military Jet Demonstration Team, ejected successfully from the Tutor just prior to the start of a performance at the 3rd *Atlanta Air Show*. Officials cancelled the remainder of the events. The aircraft impacted an unpopulated area near Brooks, Georgia, and no one was injured.¹⁴

16. 01 NOVEMBER 2019; GRUMMAN OV-1 MOHAWK (FLORIDA, USA)

A Mohawk crashed at Witham Field on the first of three days of the Audi Stuart Air Show. The Friday's activities were cancelled and the air show programme continued on Saturday.

The pilot was scheduled to perform a 12-minute routine but stated that no acrobatic manoeuvres were to be performed due to the broken 1,500 ft ceiling and 10 to 16 kts gusting wind conditions. The crew-chief stated that the pilot's, "...only reason to fly was to visually locate the acrobatic box so he would be ready for the show on Saturday. His intent was to make a slow speed followed by a high-speed pass along the show line and a normal landing to a full stop."

He reported that from his vantage point on the last pass when turning from base leg of the airport traffic pattern onto final leg of the airport traffic pattern, it appeared the bank angle exceeded 90°. The airplane then did a rapid right roll to an inverted position, and the nose dropped to what appeared to be 45° nose down followed by impact and fireball.

A pilot-rated witness who was on the Air Boss stand located about 3,700 ft northwest of the accident site, reported hearing the pilot announce on the radio he would do a "low show". At that time the ceiling was ragged and moving to scattered at 1,600 ft agl. The pilot was setting up for his last pass and flew parallel to the Runway 12 show line and then initiated a climb achieving about 15° of pitch, which he held for a few seconds, then the pitch increased to 35°.

While at 1,000 to 1,300 ft agl, he noted a "crisp" right roll to 135° of bank which was stabilized. The airplane continued the brisk pull as it approached 180° of bank; the speed increased and the turn radius decreased. After completing 170° of heading change, while at 500 ft agl, the witness did not notice any wing rock or longitudinal change. He did not see any attempt to unload the wings and during the last 200 ft of descent, the rotation rate increased slightly.

Immediately before impact, the airplane was in about a 60° nose low, right-wing low attitude. The airplane impacted onto the arresting system (EMAS) at the approach end of Runway 30.¹⁵

¹¹ Tom Demerly, The Aviationist, *Russian MiG-35D Loses Wing Panel During Flight Demo at MAKS 2019*, 30 August 2019.

¹² Global News, *Pilot Killed in Northern Alberta Air Show Plane Crash*, 31 August 2019.

¹³ MBS News, *Mi-35P "Flying Chariot" drops installations at military parade in Indonesia*, 9 October 2019.

¹⁴ CBS News, *Canadian Snowbird Plane Crashes During Atlanta Air Show*, 13 October 2019.

¹⁵ NTSB Accident Report, ERA20FA027, Grumman OV-1 N10VD, 1 November 2019.

CONCLUSION

Based on statistical evidence, as an international airshow community, we seem rather limited in our ability to reduce airshow accidents and incidents and we have not been able to arrest the decline effectively which raises the question: "can we afford then to just continue and accept an average of 27 accidents/incidents per annum over the past twenty years?."

We continue to lose approximately 13 display pilots per year on average and have not yet managed to consistently prevent any passenger or spectator deaths or injuries. It is pointless to introduce additional regulations, there are already enough in place; what is required, however, is 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, which includes occupational health and safety.

Considering the fact that airshow accidents is a worldwide phenomenon, there is an urgent need to preach, implement and share the 'airshow gospel' and 'lessons learned' across all countries in an attempt to reduce airshow accidents.

The purpose of this report is not for shock value; it is not to preach. It is so that we all may learn. Airshow flying is hazardous and despite all our preparations, our skills, and our training, something may still go wrong. And if something should go wrong, we only hope that others may learn from our experience, so that it won't happen again. Based on the fickleness of human judgement in the low-level display environment, we need to understand that we are the weakest link in the safety chain."