

FLIGHT TEST

Aerobatic

STORY: ELTON BONDI

ICONS

from *three Generations*



This striking painting by aviation artist Darryl Legg shows all three of Elton Bondi's iconic aerobatic mounts

ALL THREE ARE **SINGLE ENGINE**, FOUR CYLINDER, TANDEM SEAT AIRCRAFT. ALL THREE WERE DESIGNED TO TEACH THE ART OF **AEROBATICS** AND HAVE PARTICIPATED IN INTERNATIONAL AEROBATIC COMPETITION. AND MANY WOULD AGREE THAT ALL THREE HAVE ATTAINED **ICONIC STATUS**, BUT THAT IS ABOUT AS FAR AS THE SIMILARITIES GO. I AM REFERRING TO THE **VENERABLE DE HAVILLAND CHIPMUNK**, THE **LEGENDARY PITTS SPECIAL S2A** AND THE **BRILLIANT EXTRA 200**

HE first took to the air in 1946, the second in 1972 and the third in 1996. Given that they were all cutting edge in their time, these three aircraft can be regarded as historical milestones that track the evolution of aerobatic aircraft design over the past five decades.

I am grateful to have had the privilege of flying all of them extensively. Each has its virtues and vices, and each has its own unbeatable signature characteristic.

Before making a comparison of the flying characteristics of each aircraft, let's first briefly explore the historical context of each type.

ORIGINS

Unlike the other two aircraft, the Chipmunk was never conceived as a purpose-built aerobatic aircraft. Rather, it was designed as an all round military trainer, and a great one at that, which, amongst its many other virtues, is fully capable of aerobatics. In fact its aerobatic capability was so well regarded in the 1960s and 70s, that Professor Art Scholl, the legendary US aerobatic ace of that period, elected to create the 'Super Chipmunk' by mounting a modern 260hp engine on a modified Chipmunk airframe in order to compete in international competition. It was dubbed the 'American Yak' and was a crowd favourite at air shows across the US.

The Pitts S2A on the other hand was built solely for the purpose of flying (and training) advanced aerobatics, with very little compromise to anything else. The S2A is the two seat development of the once highly competitive single seat Pitts S1S.

The Extra 200 comes from the drawing board of that immensely talented engineering genius Walter Extra, and like the Pitts S2A, was built partly as an advanced trainer, hence the two seats, but also as a competition aircraft designed to compete within a specific international competition category (sadly now defunct) that limited the horsepower of participating aircraft to only 200hp.

The history of the Chipmunk is well known. It was conceived immediately after the Second World

War to replace the ageing Tiger Moth, a 1920s era wooden biplane. In being an all metal monoplane, the Chipmunk represented the latest technology of that time, incorporating many design features from WWII fighters, such as an enclosed cockpit, flaps, and so called 'blind flying' instruments, amongst other 'high-tech' refinements. I have been told that a Mk IX Spitfire handles much like a high powered version of the Chipmunk, which makes sense, given that the Chipmunk was built to train aspirant Spitfire pilots.

Ironically, the Pitts S2A, despite having been built 26 years after the Chipmunk, actually embodies an earlier 1920s era design philosophy with its wood and wire braced biplane configuration. Yet despite this, its aerobatic performance was, and still is, superb.

It is worth digressing to appreciate the contribution

that the Pitts Special made to the world of sport aerobatics. Imagine a scenario where the United States government of the 1950s, 60s and 70s were to give its two leading aircraft manufacturers Boeing and Lockheed Martin each an almost unlimited budget to create the world's finest competition aerobatic aircraft.

Whilst they were busy with that, the U.S. government continues to pour resources into selecting and training the most talented pilots from its various

air forces, test pilot academies and flying clubs to fly the new high-tech wonder machine in international competition with a stern directive to win at almost all costs. Then imagine that this fantasy American team, after all its monumental effort and preparation finally arrives in the small French town of Salon de Provence in 1972 to compete against the world's top pilots at the 7th International Aerobatic World Championships. It is at the height of the Cold War, national pride is at stake, and a modern day David and Goliath scenario develops where, despite all its resources and efforts, the mighty American team gets beaten by "Boris, a part-time weekend aerobat" flying of all things, an antiquated World War One looking tiny wooden bi-plane, which has been designed and built by "Vladimir, a local carpenter" who has no formal qualification in aeronautics and learnt his woodworking trade repairing railway sleepers.

Each
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This fantasy David and Goliath story is almost true, except that in reality America was in fact the former Soviet Union, Boeing and Lockheed Martin were actually Yakovlev and Zlin, Boris the weekend aerobic pilot was the legendary 'Charlie Hillard'; 'Vladimir the Carpenter' was actually Curtis Pitts and the 'antiquated World War One looking tiny wooden bi-plane' was of course the Pitts Special S1.

There is no question that the Pitts Special has attained a probably unassailable position in aerobic folklore. Even to this day a well flown Pitts will still give a good account of itself in advanced international competition.

The American supremacy won in 1972 was short lived, as soon Zlin and Yakovlev as well as the extraordinary Sukhoi company perfected their craft, thereby ensuring that Eastern Bloc nations would regain their

dominance of the sport. Eastern dominance was later again topped by the victorious French Team with their magnificent CAP series of aircraft spanning the Cap 20 through to the very capable Cap 232, as well as by a young emerging German engineer, Walter Extra, an aggressive competitor who had built and successfully campaigned in several Pitts Specials.

Walter decided that he could do better than the popular trend of simply hanging more power onto an ageing biplane design in order to achieve greater performance.

He realized that monoplanes with their aerodynamic sleekness had to be the way of the future; but it was always going to be difficult to build a monoplane that had the same strength, lightness and manoeuvrability as the shorter-spanned biplanes with their external wire bracing. Walter was

initially inspired by an American homebuilt monoplane called the Stephens Akromaster which later evolved into the more famous Laser 200, popularised by airshow superstar Leo Loudenslager. The early Extra 230 and 260 were Walters's first creations, and they were very similar to the Laser in that they were single seat, light-weight and highly streamlined monoplanes, but like the Laser they had wooden wings. Soon Lasers began to suffer from de-lamination of the plywood wing covering, which necessitated constant repair. No doubt drawing from Germany's experience in the manufacture of carbon sailplanes, Walter developed a carbon composite wing to replace the wooden wings. (He was also probably influenced by the earlier composite Sukhoi Su-29). Carbon allowed a much stiffer wing to be built, and this in turn meant that large almost full span ailerons could be used without risk of twisting the wing when fully deflected at high speed. Walter also designed a totally new aircraft to go with his carbon wonder wing, the very capable two seat 300hp Extra 300.

It is said that one of the first times the Extra 300 was seen in aerobic competition, Walter Extra flew his sequences with a passenger in the front seat, and despite this weight penalty the aircraft still excelled. Flying with a passenger during competition was of course pure exhibitionism, and must have seemed almost sacrilege in a world where people were stripping out items such as starter motors, radios and even instruments in order to lighten their aircraft. But Walter was simply making the point that with his Extra 300 a new era in aerobic aircraft design had arrived, and it certainly had!

The Extra 300 has a shoulder mounted mid wing which made rolling around an axis cleaner, but it also made landing a little more difficult mainly because the wing obscures any view of the runway during the flare. After a few landing incidents it was decided to move the wing down, and the Extra 300L (L for low wing) was born. The Extra 200 came after the 300L and is not simply a smaller version of its older brother; it is in fact an altogether different aircraft that has several aerodynamic refinements over its larger sibling.

The Extra has not yet reached quite the same iconic status as the Pitts Special which brought advanced aerobatics to the West. I, however, firmly believe that in time the Extra will rank alongside the Pitts as one of the classic all time greats. Walter Extra made the use of carbon technology in aerobatics popular and showed the



Francis Doherty

Page 26: In one of the few car analogies that works for an aircraft comparison, the Chipmunk is most like a classic British Jaguar

This page: Continuing the car analogy, the Extra is compared to a Porsche and below, the Pitts is like a rorty American AC Cobra



Bruce Packians



Francis Dohy

world that it is possible to build an uncompromising aerobatic performer that is fully certified and easy to fly, as well as being comfortable and practical to tour with.

If we compare these three aircraft to cars, I feel that they closely resemble their respective national heritages.

THE CHIPMUNK

The Chipmunk feels like an early model Jaguar, everything about it is purposeful, robust and somewhat stately. The cockpit ergonomics are appalling (which is typical 1940s British), and in being military any form of creature comfort is nonexistent. Regardless, the Chipmunk exudes everything that characterizes a vintage aeroplane, from the way it looks and smells to the way it handles. The entire Chipmunk experience is languid from the moment of start-up where the vibration of the engine is absorbed by the relatively large airframe, through to the taxi where the oleos ensure a smooth ride on the most uneven of surfaces. Even the take-off is relaxed with a modest acceleration followed by a 'gentlemanly' levitation. On landing the Chipmunk is extremely well mannered, it floats placidly to earth and all but the most pronounced of bounces will be discreetly hidden by the generous oleos, which make the most ham-fisted of pilots feel great. The Chipmunk is the ultimate gentleman's carriage, perfect for a quiet stroll amongst the clouds on a balmy Sunday afternoon, old chap!

THE PITTS SPECIAL

The Pitts on the other hand is like an AC Cobra. Everything about it is hard and crude. It is configured for performance with almost no compromise to anything else, certainly not to pilot comfort. Even with just four cylinders the engine is large for the tiny airframe. On start-up the entire airframe pulsates with noise and vibration which is amplified by the drum like fuselage. Not having good ear protection is

not an option in this aeroplane. The acceleration on take-off is hugely exciting compared to the Chipmunk.

In the air the higher wing loading means that the ride is harder, especially in turbulence. Yet, despite the relative lack of creature comfort, the Pitts Special honestly feels as though it is literally strapped onto the pilot's back; you really do feel at one with the aeroplane. Its response to control input is instantaneous and proportional. The Pitts is an honest aeroplane, although not as polite as the Chipmunk in hiding errors. Despite the often over-exaggerated claims, the Pitts is not as 'squirrely' on the ground as newly rated pilots claim. But it does demand assertive handling, especially when landing, when the view forward is non-existent. Drive your car down the highway at high speed with the bonnet open and you will experience a little of what landing a Pitts is like.

Flying a Pitts on your own for the first time is the closest feeling you will get to your very first solo, it is that much of a rush. However, like any aircraft, one soon gets used to it and in time it all seems quite normal - but never pedestrian. I always delight when I look out from the cockpit of a Pitts at what appear to be impossibly short wings, and then look back at the ridiculously close tail feathers which you feel you can literally reach out and touch. This is visceral 'gut feel' flying in a way that one is unlikely to ever experience with anything else.

THE EXTRA 200

Sticking with the car analogy, the Extra is like a Porsche. It is a high performance, brilliantly engineered and stylish machine. The Extra has well thought through ergonomics and some highly refined aerodynamics which combine to produce an aircraft that is smooth, precise and easy to fly.

The first time I flew one it felt so luxurious after the Pitts that it seemed almost abusive to aerobats such a finely crafted machine. The Extra makes a relatively comfortable touring aircraft, and it is also easy to land. However,

Despite the claims of newly rated Pitts' pilots, it is not particularly 'squirrely', on the ground



Bruce Perkins



Bruce Perkins

Earlier Extras have a mid-mounted wing which makes judging the landing very tricky. Later models have the low-mounted wing seen here

Extra cockpit

(Top) a masterpiece in neat layout compared to the fifty year older **Chipmunk** (middle) which even has a G-meter bolted on as an after-thought.

Pitts cockpit

below is a tight fit with minimum space for instruments. Note GPS bolted underneath



Ethan Bondi



Bruce Perkins



Ethan Bondi

because of its higher wing loading the ride in an Extra is even harder than the Pitts in rough air, and due to its great responsiveness it shows up the slightest handling error. For example, at 180 kts the most miniscule of hand movements on the stick will cause the Extra to bank dramatically. It has been said that it takes about 20 to 30 hrs before one gets used to this and gets what pilots refer to as your "Extra hands", when you can begin to fly the aircraft accurately in all flight regimes.

AEROBATIC PERFORMANCE AND HANDLING

Flying these three diverse aeroplanes has taught me two important things about the term 'aircraft handling'. Firstly, handling is relative; hence qualities such as well balanced, light, responsive, etc., only mean something when compared to other aircraft. And secondly, no matter how over-sensitive or even twitchy an aircraft may seem at first, if one flies it enough, one will get used to it to the extent that it will feel normal.

There are hundreds of variables that influence aerobatic handling and performance; a few of the more important ones include – the power to weight ratio, the wing loading, aerodynamic efficiency, the centre of gravity position, the relative size of the controls to the flying surfaces, the control arm or distance between the centre of gravity and the extremities of the aircraft, and of course the airfoil design, which determines both the G that can be pulled at any given speed before the wing stalls as well as the snap rolling characteristics. These factors vary dramatically across the three aircraft, thereby making them very different machines in the air.

Several years ago I wrote a magazine article about the Chipmunk, and in it I commented at how 'well-balanced, light and responsive' the controls were. Then I stopped flying the Chipmunk and over the next few years I accumulated a few hundred hours on both the Pitts and Extra. When I next flew a Chipmunk, after take-off I thought that someone had rigged the ailerons incorrectly. They seemed very unresponsive and I felt that I had no roll control. However, after a few moments the old Chippy feeling returned and the aircraft was again as delightful as ever. As I said the term 'aircraft handling' is relative.

In contrast, the first time that I flew the Pitts, I felt that it was too sensitive. With a roll rate of about 180 degrees a second, compared to the 60 degree a second roll rate of the Chipmunk, the Pitts was initially way too fast for me, and I could not stop a roll with anything close to the precision required for competition. But I soon got used to it and found the Pitts to be a great competition aircraft. Contrary to what one may expect, basic aerobatics are easier to fly in the Pitts than in the Chipmunk, for a number of reasons. Firstly the Pitts has an inverted fuel and oil system, along with a dramatically improved power to weight ratio over the Chipmunk. This means that in a stall turn for example, with the Pitts you have time to set up and draw an accurate vertical line before waiting for that ideal moment to yaw the aircraft over with the effective rudder. With the Chipmunk one

barely has enough energy to get the aircraft nearly vertical before the speed runs out. And one dare not get perfectly vertical or else the engine may quit because it has no inverted fuel feed. Please believe me that pointing straight up, with no air speed and no power, hence no prop wash and a totally ineffective rudder, is not going to be fun in a vintage machine that is not suited to tail sliding. Similarly, because of its slow roll rate, a pilot has to learn to use plenty of rudder in a Chipmunk to ensure a coordinated roll or else you will 'scoop the roll' and lose height. The Pitts on the other hand whizzes around so fast that only the slightest dab of rudder is required, any more than will spoil the line of the roll.

After some practice I was able to attain some decent scores in competition with the Pitts - and then came the Extra 200. I recall the dismay that I experienced the first few times that I flew the Extra in the aerobatic box at training camps prior to the 2008 National Championships. I was expecting to achieve really good scores in this highly capable 'new-age' machine, but the Extra had a few lessons to teach me first, and my initial practice scores actually deteriorated until I learnt to handle the aircraft with finesse. The angular shape of the Extra shows up the slightest error in line angle, or 'bobble' in roll, whereas the more rounded and smaller Pitts will hide small inaccuracies. In addition, the Extra 200 with its almost full span ailerons has a roll rate of over 360 degrees a second. This makes it initially difficult to stop cleanly and accurately. The ailerons on a factory stock Extra have almost no break-out force or centering force so keeping the wings level is a little like trying to balance whilst standing on an exercise ball. But like any other aeroplane, fly it enough and it soon becomes natural.

In addition to roll rate, there are many other measures of the term 'aerobatic performance'. Two of the most common are: Firstly, vertical penetration, (or height gained in a vertical up-line); and secondly, the straight and level speed vs. the entry speed required for upward looping aerobatic manoeuvres (e.g. stall turn, loop, etc.). If the straight and level speed is greater than, for example, the speed required to loop, then this means an aeroplane will not have to dive before commencing a manoeuvre, which in turn means that it will be able to maintain height throughout a sequence, depending of course on the complexity of the manoeuvres.

The differences between these three aircraft are so great that it is almost not realistic to compare the vertical performance figures of a 1940s trainer with more modern aircraft, as evidenced in the performance table.

From a VNE dive at 5500 ft, the Chipmunk will gain about 600-800 ft and still just be able to cap off cleanly, the Pitts S2A will gain about 1000 to 1200 ft and the Extra 200 about 1600 to 1700 ft. These numbers will of course vary greatly depending on the density altitude on the day and the G pulled in getting to the vertical. Given that the Pitts S2A and Extra 200 have the same engine and the fact that Pitts is lighter, the superior performance of the Extra is all down to its clean aerodynamic design.


With the Chipmunk and Pitts S2A there is no way that height will be preserved during even a very basic aerobatic sequence on the Highveld, but with the Extra 200 it is possible to maintain altitude until the fuel runs out, provided that you limit your sequence to simple Sportsman aerobatics. But snap it, tumble it or do any energy depleting manoeuvres and you will lose height.



CONCLUSION

I am glad to have flown competition in all three aircraft types, as each aircraft teaches something new. The Chipmunk provides a solid grounding and teaches the core fundamentals of aerobatics such as energy management, and the coordinated use of rudder. The Pitts introduces one to the world of more advanced aerobatics and teaches you to snap roll and to fly inverted with as much comfort as upright flight. And finally, the Extra introduces new levels of precision, and provides a foundation to the infinite world of gyroscopic manoeuvring. Although I am today able to fly in ways that I never imagined would be possible when I learnt to fly all those years ago, I know that there is still much more to learn. I am not even at the half way mark on the knowledge and skill curve. The aerobatic performance offered by today's cutting edge machines such as the Extra 330SC, the MX range and the new generation Edge V3 makes the Extra 200 look well... silly.

The progress in aerobatic design has steadily improved over time, with spurts of accelerated advancement, such as when the Pitts was introduced, or when the classic long wing Zlins first experimented with gyroscopic flight, and of course when Sukhoi and Extra introduced carbon wings. The last few years in particular have seen significant advancement in aerodynamic efficiency, weight reduction and power plants. This has no doubt been spurred on by events such as the Red Bull Air Race series.

One thing is for sure, as capable and manoeuvrable as designers make aerobatic aircraft, pilots will soon adapt and quickly master the machine, before again seeking even higher levels of aerobatic performance and precision. 

Flying a Pitts is visceral 'gut feel' flying in a way that one is unlikely to ever experience with anything else.

| | DHC-1 CHIPMUNK | PITTS S2A | EXTRA 200 |
|-------------------------------|-------------------|--------------|--------------|
| SPECIFICATIONS: | | | |
| Horse Power: | 145 | 200 | 200 |
| Empty weight: lbs | 1500 | 1,000 | 1,199 |
| Gross weight: lbs | 2015 | 1,575 | 1,914 |
| Power loading: lb./hp | 13.9 | 7.9 | 9.5 |
| Wing loading: lb./sq. ft. | 8.2 | 12.6 | 16 |
| Fuel capacity: US gals | 23 | 24 | 30.6 |
| PERFORMANCE: | | | |
| Never exceed speed kts | 173 | 180 | 220 |
| Cruise speed (75% power): | 90 | 110 | 150 |
| Stall speed: | 40 | 48 | 56 |
| Rate of climb; gross, SL: fpm | 900 | 1,200 | 1,600 |