BRISBANE VALLEY FLYER

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BRISBANE VALLEY SPORT AVIATION CLUB INC

Watts Bridge Memorial Airfield, Cressbrook-Caboonbah Road, Toogoolawah, Q'ld 4313.

Rob Knight (Editor) Tel: 0400 89 3632, Email kni.rob@bigpond.com

Propeller tips and forces. See page 5

Peter Ratcliffe (Pres.)	0418 159 429	Ian Ratcliffe (Treasurer)	0418 728 328
John Innes (Vice Pres.)	0417 643610	Acting Secretary	0418 159 429

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Our website - **bvsac.com.au**

Greetings Members,

Another month down and the weather is getting a little better for flying.

A few club members undertook a fact - finding venture over the week end (OK, a self-funded jaunt down to Fly in for Fun). Included in the group were myself, plus Ian, David, and Dale Myer, and our destination was Parkes.

With our other commitments, it had to be a quick trip down, and we left in the car on Thursday morning and arrived back home late on Sunday.

The event at the Parkes airport was very well organised and located on the HARS aircraft museum land. There was a lot to look at and a few new aircraft to see and there were a few exhibiters there as well. There were a good number forums all day Saturday and Sunday and these were well attended.

It is set down to be run again in two years. Overleaf, I have provided some photographs we took on the trip.

From closer to home - the last meeting was well attended and most stayed for the BBQ after the meeting. Hope to see you all at our next meeting.

Best wishes

Peter Ratcliffe
President BVSAC

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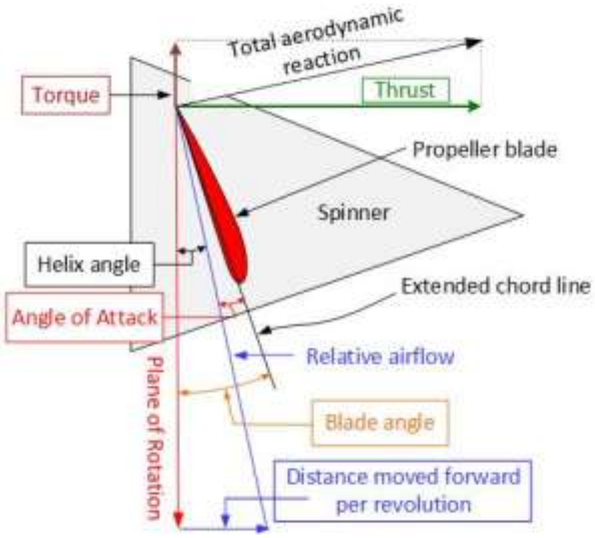
Forces on a Propeller

By Rob Knight

The propeller converts the rotary (torque, or turning effect) motion of the power into a straight-line path – thrust - that we harness to move an aeroplane through the air.



Thrust and torque, aerodynamic forces on the propeller.

The propeller is simply an aerofoil with each portion of the blade at a small angle of attack advancing along a spiral path that is the resultant of both the rotational speed and the forward speed of the aeroplane.

As a result, there is a total aerodynamic reaction which, for convenience, is resolved into two forces, **thrust** acting along the line of the propeller shaft, and **torque** acting along the line of rotation. See upper section of image on the left.

As this sketch shows, propeller blades are simply wings and, as such share the same aerodynamic forces of lift and drag only, with propellers, they are known as thrust and torque respectively. However, because the propeller is rotating to gather its airspeed and the wings don't (at least on fixed-wing aircraft), a propeller has the additional forces of rotational speed providing centrifugal force, and forward acting momentum.

Thrust force: thrust production is the sole purpose for having a propeller at all. As said, it is a wing that is rotated to provide airspeed and set up in a manner that enables an aerodynamic force we call the total aerodynamic reaction to point roughly forwards, at a right angle to the relative airflow, and ahead of the aeroplane. We take the forward pointing component of this force and call it thrust, and use it to propel our aeroplane forwards. The other component we call torque and it acts against our direction of propeller rotation. See the sketch above.

Most thrust is produced at about 75% out from the propeller boss.

We might assume that thrust is produced across the length of each propeller blade but this is not the case. There is considerable variation in thrust produced along the blade, root to tip. The section of the blade that is the most efficient at producing thrust is the area around 75% of the blade span root to tip. Inboard, losses at the boss[1] are due to shape and thickness (for strength), and engine shielding by cowls and radiators etc. Outboard of the 75% area, losses in thrust are due to pressure induced spillage around the blade tips, and compressibility from the high tip-speed of this section of blade due to RPM and distance from the boss or hub. An American light aeroplane propeller producer, Prince Propellers, have a turn-down, or turn around, on the tips of some of their designs to reduce spillage at the tips to increase efficiency, and assist in controlling noise. They are called P-Tips and act in exactly the same manner as

Prince Propellers' "P-Tip" blade.

[1] Propeller boss – the centre part of a fixed pitch propeller.

turn-downs on wing tip – they reduce spillage from the high-pressure side of the tip to the lower pressure side and improve efficiency by minimising induced drag.

Torque force: the rotation of the propeller causes a torque force (turning moment) which opposes the engine (via the propeller shaft) and tries to roll the airframe in the opposite direction to the propeller rotation. Whenever the propeller RPM are constant, the propeller torque must be exactly equal to the engine torque.

But thrust and torque are only two of the forces that act on a spinning propeller. In reality, there are a tortuous number of others acting on it. As given, some are aerodynamic and designed deliberately for the propeller to do its job, others are the results of rules of physics, and the characteristics of spinning masses. In some cases, notable forces act on just one part of the propeller arc and so generate other stresses and changes that a pilot must control in order to operate the aeroplane to which he or she is attached.

For a start, the act of spinning creates a centrifugal force pulling each blade away from its boss, or hub if the blade is individually removable. This is that same force that holds the milk in the bucket when you spin it over your head (so long as it's spun fast enough to generate enough centrifugal force). As in the case of the milk, the faster the spin, the greater the centrifugal force, also, the greater the mass the greater the centrifugal force. Generally, propellers spin at rates in excess of 2200 RPM[2] so the force generated is considerable

OK, so centrifugal force pulls the blade away from its centre. This is logical and can easily be visualised. However, that centrifugal force has another more sinister manifestation – it also tries to change the propeller pitch. It wants to fine the pitch by reducing the blade angle.

Called the *centrifugal turning moment* (CTM), this is most easily explained through the images below. In FIG 1, the centrifugal force can be seen emanating from the base, a force pulling outwards because of the rotation that can be divided into two parts, A and B. These parts, A and B, act through the leading and trailing edges of the blade so are influenced by the blade chord[3].

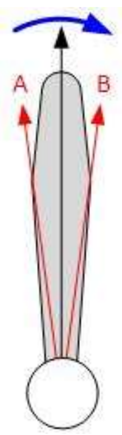


Fig 1. The CTM.

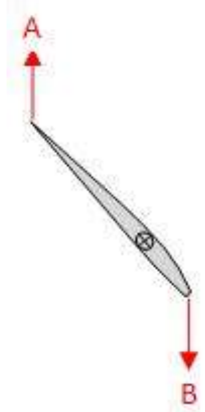


Fig. 2. The CTM.

Left: Forces A and B combine to form a moment about the longitudinal axis of the blade and apply a force that would move the blade pitch to fine by reducing the blade angle.

However, partly countering the CTM as depicted left, another aerodynamic force acts to try to coarsen the pitch when the propeller is operating. It's called the *aerodynamic turning moment* (ATM). The ATM is a direct result of the location of the aerodynamic centre of pressure acting on the propeller blade chord line.

[2] RPM - revolutions per minute.
[3] Chord – straight line length from leading edge to training edge of propeller blade.

We are all familiar with the Centre of Pressure on an aeroplane's wing aerofoil, that point that acts on the chord and through which all the lift forces may be considered to act. Guess what? The propeller has a centre of pressure too. It also acts on the chord at a similar point to the wing aerofoil, a spot roughly 1/3rd of the way back from the leading edge. As this 1/3rd point is ahead of the blade axis, it exerts a twisting force pulling the leading edge of the blade in the direction of the thrust, i.e., coarsening the blade angle and pitch.

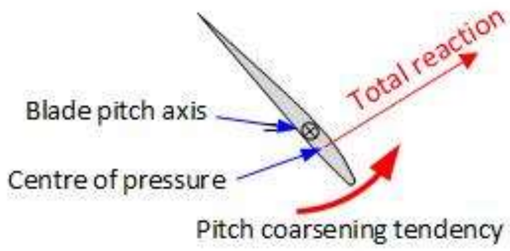
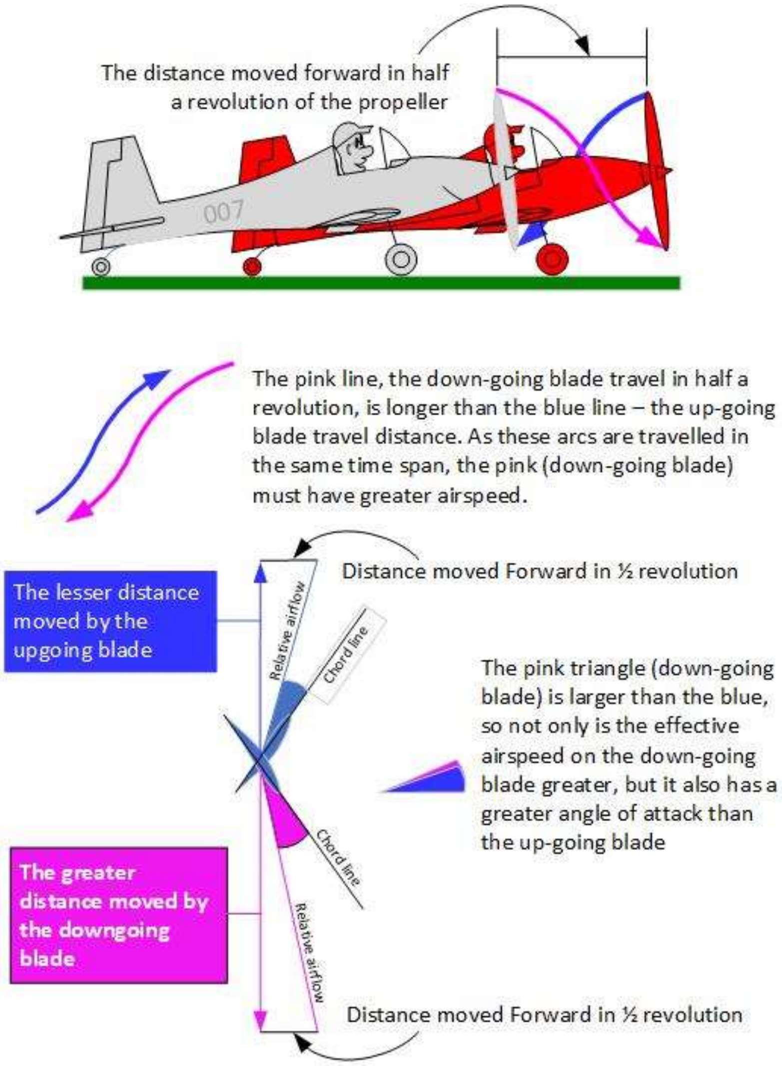


Fig. 3. The ATM (Aerodynamic Turning Moment).



"P" Factor, or Asymmetric blade effect.

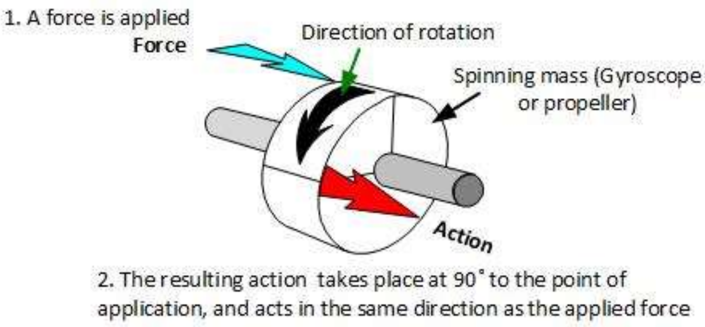
Another aerodynamic issue with propellers occurs when the propeller is moving forward at an angle, so its axis is tilted. By this I mean that the plane of the propeller's plane of rotation is not perpendicular to the line of movement. An example would be when a tail dragger is taking off, but the tail has not been raised.

The root cause of the issue is that the up-going blades in this situation have a different angle of attack to the down-going ones. This might sound non-sensical, but it's an absolute fact! See the sketch on the left. Check pink against blue.

In powerfully engined tail draggers, this is a serious impediment to taking off.

The aircraft yaw must be controlled but there's little if any rudder authority because the rudder is shielded by the fuselage ahead and there's no airspeed anyway. In this case, differential braking or a powerful steerable tailwheel are a pilot's only friends because it's only these that will provide directional control to keep the aircraft on the runway. However, as brakes require traction via the tires to function, wet or slippery surfaces make this very hazardous, and on wet grass, particularly if it's sloping laterally, pilots may need to operate at reduced loads or go somewhere else until the strip dries.

A spinning propeller is, to physics, merely another spinning mass. And, in keeping with all spinning masses, it therefore has the characteristic of precession. It's perhaps easier to show what precession is rather than explain it, so I'll start by saying that if a force is applied to the axis of a spinning mass, the change to the spinning mass will be in the direction of the force applied, but moved 90° from the point of application in the direction of rotation.



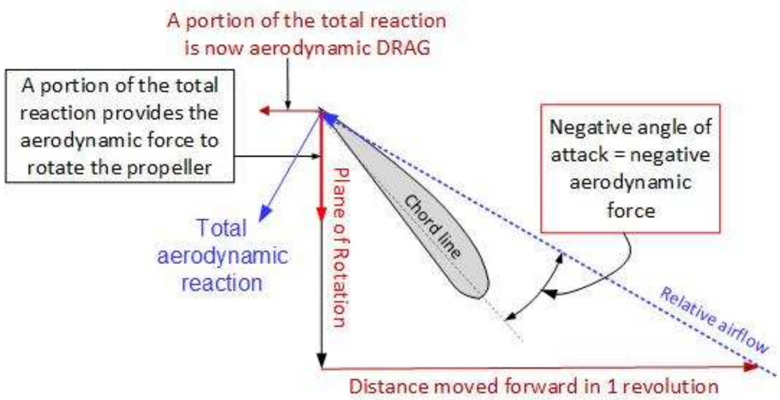
A force is applied to a spinning mass…….

The simplified sketch on the left depicts such a spinning mass. It will have the characteristic of rigidity, i.e., it will stay exactly as it is unless acted upon by some outside force. Here, we have applied the outside green force to the gyro which we might expect would tilt the gyro clockwise (near-end down), but, instead, because of precession, the gyro will **YAW** to the left as indicated by the red resultant, after precession. Had the gyro been spinning in the other direction, the yaw would have been to the right in this case.

This is one of the powerful causes of nose swing on take-off. When the aeroplane is pitched nose up or down, there will be a corresponding yaw, A nose-wheeled aeroplane, when pitched up to lift off, will suffer a tiny bit, but a taildragger pitching nose down as the tail is lifted will see a far more noticeable nose swing. This has been sufficient, where the pilot is unwary or inattentive to cause the aircraft to leave the runway against the pilot's wishes! Also, performing aerobatics, gyroscopic precession is noticeable and must be controlled by the pilot to avoid consequences.

Exercise. Take a wheel and axle from a golf trundler and hold it in your hand like a mushroom with the wheel on top. Spin the wheel clockwise and, while it's spinning, try to tilt it forward. It will resist your tilt, but will immediately, powerfully, and automatically roll to the right (be careful, don't drop it.). The tilt force you applied forward has been moved 90° to the right (because that's the way it's rotating) and the spinning wheel wants to tilt right. Stop the wheel and try again. Now you can tilt it forward with total ease. There's no tilt or roll right, so the action that you experienced was purely because the mass of the wheel was spinning. That's precession!

There is another force that has an effect on the propeller that is seldom considered. It doesn't create issues, except if the engine fails and isn't producing power. The issue causes the propeller to continue to revolve and that causes substantial drag. The issue is the force that causes a propeller to windmill when in flight with the engine either throttled back and producing no torque, or has failed, with the same result



The windmilling propeller.

Since the propeller is free to turn, it acts as a windmill, with the force of the air turning the propeller. The body of the propeller in the airflow causes drag, anyway, however, if the airflow ALSO continues to rotate the engine, that causes extra drag.

To counter the windmilling issue, and to minimise drag, some variable pitch propellers can be coarsened (the blade angle increased) until the blade is almost parallel to the airflow. This is known as "feathering", and a propeller in this state will either not windmill at all, or will only windmill very slowly. In either case, the drag is diminished markedly.

Feathering propellers are more common on multi-engined aeroplanes, these have their engine and propellers in their wings so the asymmetric drag creates control issues for the pilot when an engine stops.

Primarily, feathering propellers on single engined aeroplanes are exclusively fitted to motor gliders so they can use their engines to climb to altitude and the shut the engine down and feather the propeller for an (almost) drag free gliding experience.

The last two forces I'll discuss are both related to the forces that attempt to bend the propeller.

Torque bending: the torque bending force is the natural resistance of the air producing resistance against the blades as they rotate, and the resulting inclination of the propeller blades to want to bend in the opposite direction to that of the rotation. As the engine spins the propeller, the inherent drag from the atmosphere tries to bend the blades against the direction of rotation


Thrust bending on the propeller of the Colby-503 in flight.

Thrust bending: this is more noticeable on very light aircraft especially those with propellers manufactured from plastic or some composite materials. The force of the propeller pushing the air backwards is the most dominant force on the propeller and places the blades under considerable pressure which is sustained throughout any flight. Over time, the blades tend to lean or bend forward towards the tips.

There seems to be little evidence that a thrust bent propeller constitutes a hazard and some instances of it seem very pronounced. However, if any concerns are raised, a call to the manufacturer would be wise.

Happy flying

Yesteryear's Lear Jet - The Spartan 7W Executive

By Rob Knight

The Spartan Executive, the Lear Jet of its day, enjoyed a 170 knot plus cruise, for more than 800 nm range, and all with 5 pax. Rare - only 40 examples of the Executive were ever manufactured.

In 1931 the Spartan Aircraft Company in Tulsa, Oklahoma, began production of its C2 aircraft. Designed by Rex Beisel (most famous for leading the design team that produced the F4U Corsair) It was a strutted low winged design, unusual for its time by having side-by-side seating. The engine was a small, a 55 hp, Jacobs L-3 radial type, driving a wooden two bladed propeller.

The unlikely forerunner – the Spartan C2.

Part of Spartan's sales pitch to purchase their trainer aircraft was to offer free pilot training and they then produced 2 examples incorporating 155 hp Jacobs radial engines for use in their flying school. The power race for Spartan was on and this would culminate in the World-Class Executive model.

While Spartan aircraft were generally viewed favorably by the public, the company failed to achieve comparable success with the other prominent aircraft manufacturers of the day: a new angle needed to be found to give them a market edge. With this need of a new strategy, Spartan's seventh aircraft design was not only top-of-the-range for the time, but was destined to ultimately regarded as an aviation art deco masterpiece.

1936 advertisement for the Model 7 design. Note the sharply forward-tapering wingtips.

The seventh design was a serious attempt to have an aircraft that was a bit of all things attractive to executive aircraft purchasers – fast, luxurious and easy on the eye so it would appeal to corporate executives. The planned cruise target was 200 miles per hour (174 knots) with a range of 1000 miles (870 nautical miles), all in Rolls-Royce comfort.

Destined to be known as the Model 7X, the new design comprised an all-aluminum skin to replace virtually all contemporary doped fabric designs. Its skin surface was to be polished with the absolute minimum of protrusions to add to the skin friction drag and thus assist with the cruise speed target. Two models were initially proposed, a Standard Seven to be fitted with a 260 H.P. Jacobs engine and a Super Seven using a 400 H.P. Pratt & Whitney engine.

The initial experimental prototype, designated as the "7X", and registered as X-13994, flew with an experimental Jacobs engine of 260 H.P., attached to a Hamilton Standard ground adjustable two blade propeller. Construction began in 1935 and it first flew on March 8, 1936. Alas, the test flights proved a need for significant design changes to improve the cruise speed to meet the target values and more power to also assist in this. The airframe was subsequently re-fitted with a certified 285 H.P. Jacobs radial engine driving a Curtiss-Reed fixed pitch propeller. What emerged from the factory after these design mods

Spartan 7W-2, registered NC13993 and now housed in the EAA Airventure Museum.

were completed was an aircraft appearing very similar to what is now recognize as a Spartan Executive and the production models now carried the type 7W designation.

Records indicate that thirty-four 7W Spartan Executives were built. However, also manufactured over the period were two additional aircraft that look like a Spartan Executive constructed, and more - two other models based on the Spartan Executive. That totals 38 aircraft actually based on the "executive design" were manufactured between 1936 through to 1944. Adding to this complex confusion was the Spartan company's inclination to provide performance details and sales brochure data for model variations that represented design concepts and not completed aircrafts.

Spartan 7W-31, now registered as N34SE and owned by Offeraire Inc, in Wilmington DE.

The demise of the Spartan Aircraft Company and its outstanding Model 7 design was an unfortunate side effect of WWII. As civilian life returned across the USA and the rest of the world, for those that could afford it, or had the desire to do it, fast and potentially luxurious air travel could be acquired using the super-cheap ex-military aircraft that were virtually being given away. How can you sell anything when your competitors are giving away more enticing products that you can provide.

A typical Spartan panel with the cross-over yoke control.

The very last of the line was a one-off amendment to the 7X design. Re-designated a 12W, it sported tricycle undercarriage to try to entice customers. Built in the experimental category, it was never certified and this sole example now resides in the Tulsa Air and Space Museum.

The sole Model 12W Spartan Executive was built in 1937 and can be seen in the Air and Space Museum in Tulsa, OK.

As with all aeroplanes, any flight begins with a thorough preflight inspection and, as well as all others it includes an initial check to ensure the both magnetos for the ignition are turned OFF, the fuel is checked for contamination (this aircraft has 5 tanks, each with its own trap so each one requires checking), and, being a radial engine, a pull through each cylinder compression to ensure there is no hydraulic lock that could damage the engine on start-up.

An issue in this now almost antique aircraft is that all of the fuel drains are under the belly and the pre-flighter needs to crawl under the aircraft to reach them. This can be an issue when the aircraft is on damp grass or over standing puddles and the pilot is wearing a suit.

The oil quantity check is to ensure the engine is carrying the necessary oil quantity for the proposed flight and the required reserve of oil. As radial engines are infamous for both using and leaking oil, this check is as vital as checking the fuel on board is sufficient for the flight. A last point regarding the oil, the quantities are so much larger than aircraft with more conventional engines, the oil dipstick markings are in US gallons, not quarts pints or litres.

Engine starts are different. Whilst most aircraft equipped with in-flight variable propellers should be started in their full-fine position, the Spartan MUST be started in full coarse instead. This ensures that as much oil as possible remains to flow through the engine-oil galleries whilst the oil pressure is low. Only after the engine has started and the oil pressure has risen to indicate that full oil pressure is being achieved, may the propeller pitch control be moved to the full fine position.

Once running, with the propeller now in full fine pitch, the engine needs to warm to 50°C. before taxiing the aircraft. That gives the pilot several minutes of time to turn on radios and lights and check various other systems.

Taxiing is typical for a tailwheel aeroplane; taxi speed must be slow. This is vital as forward visibility is horrible. The large engine, with its visibility-blocking cowls, requires considerable “S” turning to taxi with confidence that the pilot won’t run into anything. This 7W has been modified to include a steerable (but not lockable) tailwheel, so differential braking is still needed, particularly at slow speeds or for sharp turns.

After arriving at the run-up area, park into wind to assist with on-the-ground cooling and complete all of the items on the pre-take-off checklist. Flaps are not used for take-off. This aircraft has an accurate fuel flow gauge, so the final item to check is the amount of fuel burned during engine warm-up and taxiing. This is typically several gallons of fuel.

Full power (nominally 450 hp) is used for take-off, which is about 36 inches of manifold pressure and 2350 RPM’s but it is applied with caution and definitely not too quickly. At about 30 knots, the tail may be gently raised while adding compulsory right rudder. Raising the tail to quickly will drive the aeroplane into an immediate left turn because of the existing torque from the huge engine and large diameter propeller being augmented by the “P” factor. At about 55 to 60 knots, the aircraft is about ready to fly. After lift-off, with a positive rate of climb achieved and a tap on the toe-pedal brakes to stop the wheels from turning, the undercarriage can be raised. At this time the aircraft with full throttle is consuming around 50 US gallons (190 litres/hr. – **YES-190**) per hour, so as soon as the wheels are retracted and obstacles are behind, the power should be reduced to 30 inches with the throttle, and 2000 RPM with the propeller control for the continued climb. On reaching the desired cruising altitude, level off and trim the aircraft. With the desired power set, lean the engine and complete the cruise section of the checklist and get ready to experience flying at its best.

This Spartan is supercharged, and thus has a service ceiling of 24,000 feet. Optimum altitude for speed and economy is 9600 feet. To go fast, the aircraft must go high which will require a lot of gas. For an aircraft that is older than a beginner septuagenarian, a good approach is a bit more conservative. If flying locally for fun, throttle back to 1700 RPM’s and 25 inches. With the engine leaned to 50 to 100 degrees rich of peak, that gives about 135 knots while burning a little under 17 US gph (65 litres/hr.). Across country, and flying at altitudes not above 5000 feet, the aircraft can be cruised at about 170 MPH (about 150 knots) while burning close to 21 gph (80 litres/hr.). With it's big 450 hp radial engine, the Spartan will go faster if desired and the higher fuel consumption is acceptable, but that remains the pilot's choice.

Level flight – in cruise - is where the magic of this aircraft is most evident. Its feel is rock solid, and quiet enough that headsets are not really needed. With the smooth and throaty sound of the engine, it is almost like riding passenger in a diesel locomotive but without the constant clatter of the wheels crossing the rail links.

To illustrates the advantages of the design, flying from Wisconsin to Oshkosh for the EAA's annual AirVenture, the trip takes about 3.5 hours in the Spartan, and 12 hours in a car. However – that's NOW. Back in 1939, such a trip by air would still take 3.5 hours, but by car, with the quality of the cars and roads in those days, the drive time could not have been less than several days. Now that's a good marketing point.

Landing the Spartan is not difficult, but attention is very definitely required. The wing flaps are electric and controlled with one switch, and its belly flap with another, so two flap controls must be manipulated correctly. Both wing and belly flaps extend to 45 degrees, and so they are quite effective in steepening the approach and the difference in stall speed between flaps up and fully down is noticeable, around 8 knots. Thus, while approaches and landings can be made using no flaps, full flaps and anything in between, it is more common to have the flaps fully extended to enable touch downs at the slowest possible speed and minimize the landing roll-out required.

With a MTOW of 4400 pounds, the 7W is a somewhat heavy aircraft and there is a vital need to be ahead of the aircraft with small, smooth pitch and power changes during approaches and landings. Many pilots prefer wheel landings because the Spartan visibility is so poor ahead in the 3-point attitude. Like all taildraggers, flying doesn't stop until the aeroplane is tied down.

The normal shutdown procedure is to move the prop control to full course pitch then idle at 1000 RPM's for about a minute before pulling the mixture into the idle cutoff position. Check and confirm that all electrics are switched off and double check to be certain the magnetos are switched in the off position.

GENERAL SPECIFICATIONS AND PERFORMANCE:

Crew & Passenger: Crew one, Pax - 5	**Propellers:** two bladed Hamilton Standard CSU.
Length: 26 ft (7.92 m)	**Never exceed speed:** 277 mph (241 knots).
Wingspan: 39 ft (11.89 m)	**Maximum speed:** 257 mph (223 knots).
Height: 8 ft (3.15 m)	**Cruise speed:** 215 mph (587 knots) at 10,200 ft.
Wing area: 250 ft^2 (19.28 m^2)	**Stall speed:** 68 mph (59 knots) (flaps down)
Empty weight: 3,180 lb (1,442 kg)	**Range:** 1,519 miles (1,320 nm at long-range cruise.
Max. take-off weight: 4,400 lb (1995.8 kg)	**Service ceiling:** 24,000 ft
Powerplant: Pratt & Whitney R-985 9 cyl.	**Rate of climb:** 1,400 ft/min.

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Behind The Piper PA28 140 Cherokee

By Rob Knight

Aviator or not, it's almost impossible that anyone has not heard of a Cherokee. They are ubiquitous in the western world and are prominent in every I.C.A.O. signatory country.

So why are these aeroplanes so popular? The Piper PA-28 series (from the 140 to the 235) has been a major success story in that from its first production in 1961 until now, 39,742 examples of the various PA-28 models have rolled out the doors of the Cherokee manufacturing plant in Vero Beach in Florida and more than 90% of that number are reportedly still flying. This must be an example of the personification of popularity.

To understand the reasons behind the popularity of this aircraft, let's talk a short walk through a little history.

In the period of WWII, Piper produced the Cub, in civilian forms and some special purpose examples for the US military. These have been referred to as the "long Wing" aircraft in light of their relatively high aspect ratio, relatively wide-span designs compared to Piper's later designs. The "short Winged" pipers began with the PA-15 Vagabond, produced in Piper's Lockhaven plant and first flying in 1947. The design was intended to look good, provide good performance on low engine power using a fabric covered metal tube construction for the airframe. The PA-15 design was further developed and culminated in the PA-22 Tri-pacer and Colt, finishing production in 1964. The initial design for this series was to ensure the aircraft displayed stall characteristic that would make it difficult to inadvertently spin. At this time, this safety issue had led Stinson to design their aircraft with an elevator stop on the flaps. Full up elevator was possible only with the flaps down. This was supposed to reduce the chance of stalls developing into spins. Another manufacturer, Ercoupe, designed an interconnecting rudder with restricted elevator travel. Any turn had built in coordination so excessive yaw at or after a stall was impossible; here, no crossed-control situation could ever occur.

A 1947 Piper PA-15 Vagabond. The first of the "Short Winged" series.

The short-winged Pipers were given a relatively high thickness/chord ratio airfoil (USA-35B) that had the point of maximum camber at 40% chord. This used laminar flow to ensure that lift would be lost more slowly at the stall. It eliminated the sharp break as the streamline flow over the upper surface of the aerofoil broke away as the critical angle was exceeded as occurred in aerofoils with the point of maximum camber closer to the leading edge. It worked – it softened the break when CLmax was lost as the stall occurred. In flight, this wing design allowed the stall to develop and the plane would rock back and forth instead of pitching forward while at a dramatic sink rate with, perhaps a wing drop. Only a very aggressive pitch could get a sharp break and spin. It worked. And when Piper looked at what they would produce after the PA-22, they determined to include this stall characteristic into their next design.

At Ardmore, New Zealand, ZK-CEQ, no 52 off the first production line of the PA-28-140 in 1964. Note the aerofoil shape at the wing tip. Serial number is 28-20052

The PA-28 design was an epochal change. Gone were the rags and tubes of the Vagabonds, Pacers, and Colts, in was a new, low winged, modern-looking, all-metal design, marking Piper's step-up to the future. Wanting to see the gentle stall in the new design as in their "short winged" series, they used the NACA 65-415 aerofoil to achieved their aim. The gentle stall quality was now a feature carried through in both high and low wing Pipers. When Piper re-designed the PA-28 wing in 1974, adding a double taper (leading edge and training edge) to the outer sections and increasing the span, the change did little to alter its in-flight characteristics. The re-design was to influence the approach characteristics so that, at the critical approach speed, instead of excessive sink when slow, as experienced with the short, constant chord (Hershey bar) wing, the aircraft instead displayed excessive float when fast, with the tapered one.

The design met with instant success. In 1964, its closest competitor for customer dollars was the Cessna 172D. Below is a short comparison of their specifications and characteristics.

Specs and Performance	PA-28-140	Cessna 172D
Maximum Take-off Weight:	975 kg (2150 lb)	998 kg (2200 lb)
Wing span:	9.144 M (30 ft 0 inches)	11.00 M (36 ft 1 inch)
Wing area:	15.8 M2	16.17 M2
Engine and Power:	Lycoming - 140 hp	Continental - 145 hp
Propeller type:	74 inch, metal, fixed pitch	76 inch, metal, fixed pitch
Best Rate of Climb at sea level:	631 fpm	645 fpm
Cruise speed (at 2400 RPM):	94 ktas	96 ktas
Take-off over 50 ft:	1697 M	1525 M

Flown properly, there was not a lot between them.

As with all humans given choices, aeroplane types and manufacturers have their loyal adherents and detractors. As the PA-28 was brand new, it was competing with many already confirmed Cessna 172 loyalists which formed a formidable group. Certainly, many Tri-pacer lovers would rather die than purchase a 172, and so looked more favourably on the new "140", but, even so, they were hesitant to give it their full support.

But things changed quickly. The gentle stall characteristics quickly made many friends, especially as the 140 was sold for use as a Club or School trainer. Instructors were especially pleased as the 140 cockpit was two inches wider than the 172 and a whole FOUR inches wider than the Cessna 150, the most prolific pilot trainer at that time. Sure, it did have a slightly longer take-off roll than either the 150 or 172, but that was only academic on the airfields being used.

But it was the foresight from Team Piper that provided the platform that was the 140's best selling points. That NACA 65-415 aerofoil, so forgiving in the stall and giving a much more gently ride through turbulence, quickly sold the aircraft and its body of loyal admirers grew exponentially over the following years.

However, it was not all wine and roses. The 172 of the day had a payload weight advantage of 49 kg which could make a big different when planning a flight where range between fuel stops was an issue. Also, the early 140 had no luggage area, the back of the rear seats butted up against the back wall of the cabin which often restricted the aircraft to a maximum of 3 POB[4] when overnighting, the 4th seat being used to carry the bags.

[4] Persons on board.

Another point raised against the 140 was that there was only one door, fitted adjacent to the front seat on the starboard side. This meant the pilot, flying left front seat, was the third person to board and had to reach around the front passenger after they were seated to shut and latch the door which was fitted with two latches, a lower one to lock the door frame to the fuselage side, and a top catch to hold the door to the top of the fuselage. In an emergency, it was argued, the pilot was trapped until they got the front seat passenger out. However, although much discussed, there seems to be no actual issues associated with this door design in accident reports throughout the life of the aircraft which has now spanned some 60 years as the design is still in production in 2024.

A 1964 PA-28-140 panel with a black push/pull throttle and red mixture control.

From an operator's perspective, the 140 was notably cheaper to operate. The Lycoming engine had 2000 hours TBO, whereas the Cessna 172s of the day, running the Continental 0300, was TBO'd at just 1800 hours. This gave the 140 a whole 200 hours extra run-time between overhauls – 10% extra - to generate the cash for the overhaul. Fuel consumption was on a par so there was no advantage there, but Lycoming parts were slightly cheaper. The greatest difference between the two types was the airframe running costs. The 140 won hands down on the dollars/hour it took to keep the aircraft on the line. The Cessna lost on two accounts – the design was more complex and it took more man-hours to maintain them, and the parts were more expensive to purchase when required. A less significant issue might also have been that the Cessna design was a little more prone to damage from hard landings. The air/oil oleo struts on the 140 seemed to give very little trouble, but heavy landings on the flat-spring main undercarriage legs on the 172s could cause main leg-mount damage resulting in very costly fuselage repairs.

Operating the two types on the same flight line quickly showed other advantages in the 140. Apart from operating costs, the 140 tended to bring in more revenue. On days when the weather was less than clement, the tolerant characteristics inherent in the 140 allowed it to remain active after the 172s (and 150/152s) had been tied down or hangered. Obviously, this added notably to revenue raising, a factor vital to any business operation.

From an instructor's standpoint in comparing the two types, they each had their good points. The 172 you climbed up and into light, the 140, down and inside, into shadow. Taxiing, like in all high-winged aircraft, gave the 172 the advantage of being able to see the main wheels and therefore place them more accurately in regard to marker boards, cones etc. However, in stronger winds, the 172 was prone to directional control difficulties because of its greater keel surface, and, because its wing is so much higher from the ground, rocking alarmingly in strong crosswinds, even possibly touching a wing tip on the ground in extreme conditions. Some operators required wing-men for all ground operations when the surface wind exceeded 20 knots.

Teaching taxiing, the 140, with its direct mechanical linkage to the steerable nosewheel, had a solid and positive feel to the rudder pedals. The Cessna aircraft, with their indirect linkage, did not, and the soft, lighter and springy feel to the pedals on the 150/152 or 172 aircraft took longer for the student to gain confidence and thus competence in taxiing. Also, with the higher centre of gravity on the high-winged aircraft, rolling whilst taxiing, especially in strong winds, was confidence dashing and slowed training, but this is an issue with the wing position and not the type.

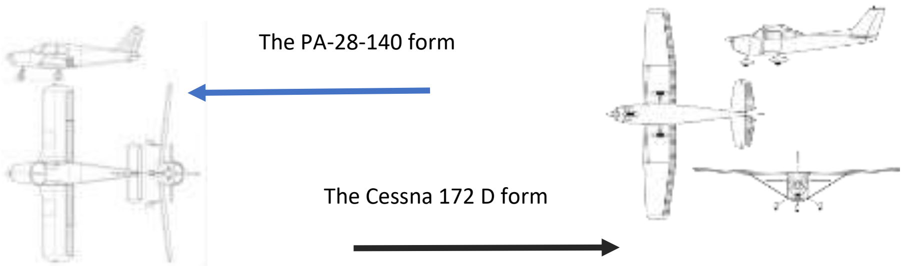
In level flight, there were no advantages between the 140 and the 172. The usual and well understood limitation of lookout being impossible in turns in the 172 was countered by the difficulty in teaching map-reading and visual navigation in the Cherokee with a wing always in the way. Cruise speeds were very similar as was the rate of climb. When gliding, the 172 did have a greater range but this is academic and is not seriously an advantageous attribute.

It was in the stall, and carrying out approaches that divided the aircraft in their inherent characteristics and provided more significant differential between the types.

In the stall, the Cherokee had a comparatively and seriously high nose attitude, much higher than the 172. This was caused by the 140s greater span-wise flow created by their lower aspect ratio wings changing the angle of the approaching relative airflow from which the angle of attack is measured. AT the stall, the 140 nodded its nose and then it sagged as the stall broke, just as Team Piper had determined. Recovery was simple and quick – stick forward just enough to unstall (reduce the angle of attack to a value minutely less than the critical angle, adding full power to minimize height loss. There was very little stall-created yaw. Maintaining directional control really just meant the same four things as when countering swing on take-off. These included

- Opposing the yaw effects of adding power at low speed (slipstream effect),
- Preventing adverse yaw from the aileron use necessary to counter propeller torque,
- Countering the gyroscopic force from the nose pitch down to unstall and exit the stall, and
- Countering the ever-present ”P” factor when the spinner is not pointing along the aeroplane’s flight path and thrust is being produced.

Thus, from learning to take-off, the control movements in magnitude are relatively familiar and easy to accomplish so confidence builds easily. Conversely, the different wing plan on the Cessna gave it less spanwise flow and thus a lower nose attitude at the stall. The Cessna aerofoil, a modified NACA 2412, produced a noticeably sharper break. A graph of CL against angle of attack gives a much sharper peak and drop-off in lift (with a savage rise in drag) after the critical angle and CLmax have been exceeded. With that sharper break and greater drag rise on the stalled 172 wing, came a greater propensity for a wing to drop and the aircraft to yaw towards that dropping wing. This immediately created the need for more complex control inputs to make a satisfactory exit and minimize height loss. The greater complexity of the 172 control inputs necessary to exit the stall required more training (on average) and student competence was harder to achieve than in the 140. It cannot be said that the 172 was more difficult/more dangerous to exit a stall condition, but the characteristics inherent in the design generally took longer for the student to take on board and be confident and competent with. This does not in any way suggest the 140 was not an adequate training platform, and a well-trained student would never be compromised because they learned stalling in a 140. After all, this is exactly why conversion training is required for pilot competence when changing aircraft types.



Comparing the aeroplane’s forms

Whist airspeed control on approach is vital, it was extra so in a 140. The gentle stall onset could lull an inattentive pilot into a situation where the airspeed was too low to affect a flare when landing, and the aircraft could fall through its low-winged air-cushion and damage itself on the runway. The standard approach speed for the 140 approach was 70 knots, with or without flap. Short landings dictated an airspeed reduction to 65 knots on short finals, but only with flaps fully lowered. The large wing tips on the 140 creating the higher levels of induced drag set the stage for rapid airspeed reductions in any wind gradient situations or should the pilot’s attention wander. Thus, it was easy to get low and slow which was totally undesirable: the 140 horses could easily shrink to ponies and be inadequate to recover the situation. It could easily become impossible to regain a controlled and adequate approach angle. Of such situations are calamities made.

Whilst the same scenario could befall the 172, its tapered wings did not produce the same amount of induced drag, and even though its flaps were larger, the added profile drag was not so critical. The 172’s airspeed could indeed decay in exactly the same fashion as the 140, but it did so at a slower rate and there was a greater change in the feel of the aeroplane to alert the pilot. Also, with the lower amount of induced drag, a go around at low speed was not so demanding as pilots experienced in the 140.

However, after winning on the approach stakes, the 172 loses out on the float after the flare. The 172 had a larger keel surface and any cross wind created a greater weather cocking tendency than the 140 ever produced. This required more astute rudder control to keep the aircraft on the centre line. Coupled with this was the influence of the surface wind on the high-wing. There can be a sizeable difference between the wind velocity at a meter off the ground and that experienced at 2.5 metres aloft. In fact, the changes to the wind velocity can include the speed, the direction, and the gustiness over just that 1.5 meters vertical distance. The result for the 172 was that where there was any wind component blew across the runway, the aircraft required more control inputs from the pilot to maintain its location above the centre-line, and at the correct flare height with movement about the directional and roll axes under control. The 140 was definitely easier to fly in this respect, and this made instructing easier, flight tests easier to pass, and pilots confident and competent. Adding to these, the reduced operating costs and better bad weather utilization, it’s not a wonder that the type very rapidly became a success. While the 172 retains its now unassailable position of being the most produced light aircraft ever, the PA28 runs fourth. That in itself is no mean feat.

A PA-28-140 In the United States, at home.

PA-28-140 in Africa.

If there really was a down-side to the PA-28 design, it could be the soft ride that marvelous wing gives when penetrating turbulence. In the 1980s Statistics buffs reported that when a comparison of the fatal accident figures of the two basic types, the PA-28- and its Cessna equivalents, was made, the Piper displayed a greater number of fatal accidents. At the time it was a serious accusation from Piper’s opposition and an in-depth study was undertaken. The final analysis put the blame for the adverse statistical curves actually on the Cessna design. Its wing gave a much rougher ride when turbulence levels became severe, warning their pilots more graphically of the rising severity of the impending conditions. This resulted in more Cessna pilots abandoning their flights earlier and so making precautionary exits from their flight plans. But this is a pilot issue. How could you blame a car because it gave a softer ride and so didn’t warn you the road was getting rougher. The design was acquitted of all charges.

No man-made design is flawless, and the PA-28-140 is certainly not the personification of perfection. But, in the economics of the aviation industry, it has served the flying population well and must be considered a major success for Piper. The design stands on its own merits, and it’s now 60-year success is surely a hallmark of that accomplishment. It’s not a question of whether the Piper design is better than the Cessna’s, or vice-versa. If you are considering owning a light aircraft such as one of these, just buy the one with the problems or characteristics that you can live with.

Happy flying (be it in your PA-28, or your 172, or whatever is your brand of magic carpet).

------ ooOOoo ------

Birthing a Spitfire

By Rob Knight M24-174

In 1930, the plethora of espionage details emanating from a disgruntled Germany had many British leaders concerned at the progress being made in the military aviation arena by the Germans. Already large four engined aircraft that were purportedly developed for civilian transports were cross-over designs that could operate in bombing or long-distance reconnaissance roles for a military power and Britain had very little to counter their potential threats.

In addition to these machines, the British authorities were very aware of the expertise of the new Willy Messerschmitt and the fighter design (to be designated the Bf 109) so were encouraging British manufacturers to step up to the mark and produce in-house designs that would match the performance of their potential opposition.

Supermarine (sometimes call Vickers-Supermarine because it was owned by the Vickers-Armstrong company) successfully fended off all other contenders to win the 1931 Schneider Trophy race for the fastest seaplane felt good enough about their aircraft design prowess to submit their entry to compete for the 1931 British Air Ministry's call for aircraft manufacturers to meet with their specification F7/30. Reginal J. Mitchell got out his drawing board and the Supermarine Type 224 took shape and building began. Alas, the gull-winged monoplane with a fixed undercarriage failed to meet the opposition and the Gloster Gladiator was selected to meet the requirement. Mitchell was gutted. His sleek design didn't even match the winning biplane, also with fixed landing gear. Mind you – the Gladiator was a very capable machine, and won much glory in the Mediterranean supporting Malta 9 years later, and in Russia. Note that the Gladiator was powered by a 550 hp Bristol Mercury IV radial engine, whereas the type 224 used a Rolls-Royce 600 hp Goshawk II. And the 224 still couldn't beat it, with more power and half the number of wings. Also, the complex cooling system of the Goshawk II proved unreliable and caused further issues in reports.

The failed type Supermarine224

Mitchel pointedly sharpened his pencil again and returned to his drawing board to design out all the failure-causing flaws in his Type 224. Although terminally ill with cancer, Mitchell worked feverishly on his 224 replacement – the Type 300 and this new creation first flew on 5 March 1935. Only vaguely similar to the old design, the Type 300 was sleeker and the undercarriage folded away to reduce the drag. Also included was Mitchell's genius epic elliptical wing design, that set this aircraft apart from all its contemporaries during WWII. To illustrate how military fighter design was neck and neck at this time, note that Willy Messerschmitt first flew the Bf 109 on 29 May, 1935, Mitchell's Type 300 only beat him by about 10 weeks, but it still wasn't a Spitfire.

The Supermarine Type 300 Spitfire.

Alas, the Type 300 was also a big disappointment to Mitchell and his design team when it, too, was refused acceptance. The team then immediately began a further series of changes, including the fitting of an enclosed cockpit, oxygen-breathing apparatus, smaller and thinner wings, and the newly developed, more powerful Rolls-Royce PV12 engine, which, in later versions, became the Merlin. Mitchel, in spite of his medical issues, was convincing because, in December 1934, the Air Ministry issued contract AM 361140/34, and provided £10,000 for the construction of Mitchell's improved Type 300 design.

As part of the design revisions, and a new contract, F10/35, the armament was doubled to now four 303 Browning machine guns in the wings, and the very first Spitfire, the prototype, designated K5054, being developed.

K5054 was fitted with a new, fixed pitch propeller, and Summers flew the aircraft on 5 March 1936; during this flight, the undercarriage was locked in its extended position for safety. 5 days later, on the second flight, Summers retracted the undercarriage for the first time and the true performance potential of the design became apparent. After the fourth flight, a new engine was fitted, and Summers left the test flying to his assistants, Jeffrey Quill and George Pickering.

Quill and Pickering soon discovered that the Spitfire was a very capable aircraft, but not perfect. They noted that the rudder was oversensitive, and the maximum level-flight airspeed was just 330 mph (286 kts), little faster than Sydney Camm's new Merlin-powered Hurricane.

A new and improved profile, two-bladed, wooden propeller allowed K5054 to reach 348 mph (302 kts) in level flight in mid-May, when Summers flew K5054 to RAF Martlesham Heath, and handed the aircraft over to Squadron Leader Anderson of the Aeroplane and Armament Experimental Establishment (A&AEE). Here, Flight Lieutenant Humphrey Edwardes-Jones took over the prototype for the RAF. He had been given orders to fly the aircraft and then to make his report to the Air Ministry on landing.

Edwardes-Jones's report was excitedly positive; his only request was that the aircraft be fitted with an undercarriage up or down position indicator. Things moved fast and a week later, on 3 June 1936, the Air Ministry placed an order for 310 Spitfires, before the A&AEE had issued any formal report of its own. Interim reports were later issued on a piecemeal basis.

Intensive flight testing of K5054 was continued for the next several years, only ending ingloriously on September 4, 1939, three days after the start of World War II. According to ASN Wikibase Occurrence # 75481, the sole prototype Spitfire stalled high, bounced, and nosed over on landing at Farnborough on 4-September 39, and the cockpit was crushed. The pilot, Flt Lt Gilbert S. White, was very seriously injured and died of a broken neck the next day in hospital.

Reginal Joseph Mitchell.
B. 1895, d. 11 June 1937.

Spitfire K5054 was the only Spitfire prototype built before the aircraft was ordered into full production on June 3, 1936. After the crash, the prototype was not rebuilt; parts of the wreckage were later used to test the installation of reconnaissance cameras, and today only one piece of the airframe is known to have survived: a wing bolt that an engineer kept and turned into a sheet-metal worker's hammerhead.

After Mitchell's death in 1937, production design and future adaptations became the responsibility and work of his long-time collaborator and successor, Joseph Smith, and Smith oversaw the production trials at Martlesham Heath. But the Air Ministry was so impressed with the prototype, they ordered 310 Spitfires, and, despite the problems with Type 224, the name had stuck.

Reginal Mitchell's masterpiece proved to be not only a beautiful aeroplane, intensely loved by its pilots, but also a robust and pliable design. So much so that it was the only fighter in production before the War, throughout the War, and after the War. Its final version was the Mk XXIV, some of those marks being specialist Photo Reconnaissance (PR) planes, others reserved for the Navy and christened 'Seafire'. Versions of the Spitfire were equipped with machine-guns, cannons, rockets, and bombs, or even freight aircraft carrying barrels of beer across the English Chanel after "D" Day. It found effective used from high altitude to ground level where it was or adapted to a ground-attack aircraft.

Two marks were even tried with floats. By the end of the war, it had gone through a multitude of design adaptions, changes in take-off weight of the designs from 2414 kg to 3626 kg, and power increases from 700 hp in the early prototype, to 1850 hp in the Griffin powered versions. There were also from 13 different designs of propeller. In all, 20,351 Spitfires were produced for the RAF. The type ultimately saw service right around the world, not just in Europe, but in the Middle East, North Africa, Singapore, and the RAAF in Australia. About 40 different Spitfire aircraft remain airworthy across the world. And quite a number of new-built replicas.

A Supermarine Spitfire Mk VIII (Tropicalised) aircraft, serial number A58-672, of 457 ("Shark") Squadron RAAF, in flight over Morotai Island in May 1945.

K5054 – The Spitfire prototype. Note the large chord length and course fixed-pitch on its wooden propeller.

Converted from a MK IX airframe, now designated a TR9, a two-seat training adaption currently flying in New Zealand.

Seafire, Griffin engine, and folding wings, looking for an aircraft carrier.

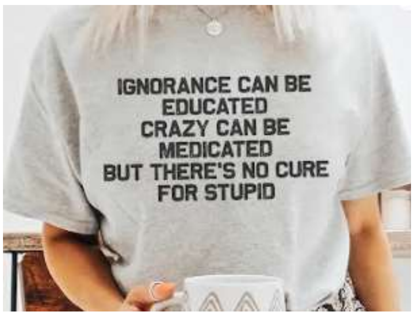
Spitfires in formation. These are different Mks, note the clipped wing-tips on the nearer aircraft.

A Mk IX, still flying in 2018

------ ooOOoo ------

FLY-IN Invites Looming

WHERE	EVENT	WHEN
Murgon (Angelfield) (YMRG)	Burnett Flyers Breakfast Fly-in	**See website for next planned event". Confirm details at: http://www.burnettflyers.org/?p=508**



The Days of Our Lives (Feedback from a Flying Instructor).

By Rob Knight

Keith was a time-poor businessman wanting to get his flying lessons early one morning per week. As I was in a position at the time to fit in with his wishes, I accepted and became his instructor for his PPL. Most booking were for 0700, a quite pleasant time in the late spring through summer and early autumn, but on frosty mornings I wondered if I was not a little bit insane. Nevertheless, I attended, Keith progressed and eventually he got his PPL. Every early flight I did with him, or supervised for him, was in my time, unpaid, as it was before my roster started.

Keith owned a foundry in Auckland City manufacturing manhole covers and other such item on contract for various local bodies in New Zealand and I recall his using the aircraft to his advantage after he qualified. Eventually he went on and got me to get him ratings on the club's four-seaters to save a little time but to also enable him to take more than a single passenger on his many business trips.

Over the next couple of years, we saw little of each other. And I had not thought of him in a long time when one Tuesday morning, at around 0500 (still dark) I was woken by a hammering on our door. This was bad news because our son, just a month old, was sometimes hard to get to sleep so I quickly answered it. It was Keith. He said he had booked a Cherokee to fly himself and two passengers to Wanganui but he'd forgotten to renew his PPL. He ordered me to I get dressed and drive out to the Aero Club and renew his PPL for him so he could fly legally.

I was on a week's leave. My wife was not well and I felt more than a little put out. However, we were also suffering the vicissitudes common to the salaries of junior flying instructors, so I cheekily said I was on leave but if he paid me for my time, I'd consider it.

Irate, red faced, and shouting, he told me there was no chance. I was a Club instructor so I should get out there and instruct – or he was going to be late – AND - he was waiting.

Obviously, I didn't. And he was late – very late. So, he complained to the Waitemata Aero Club committee about my refusal to provide the service to which he was entitled and when they didn't agree with him, he resigned from the club.

Years later I was with a group of Instructors in a bar at Ardmore and Keith joined us. He didn't see me at first but when he did, he just snorted, "Oh, you're here", and walked away. When a member of the group asked who he was, I just said he was just a prick I used to know.

------ ooOOoo ------

WTF - The World's Worst Aircraft –

The Avro Manchester 1939

By Rob Knight

Built to a specification for a medium bomber with the added complication of the potential for catapult launching at maximum take-off weight and the ability to dive-bomb, was built to be extremely strong but this had the added side effect of creating a high wing loading. In addition, it was to be powered by the Rolls Royce Vulture engine, still in development and one of Rolls Royce's only declared absolute failures. These engines were never suitable and suffered overheating with the tendency to catch fire without warning or come to a crashing stop because of mechanical part fatigue. This engine was, in effect, two engines, with one inverted above the other. But the con-rods were common so each con-rod served two pistons, one in each engine. This caused rapid fatigue resulting in common and sudden catastrophic failure with broken con-rods piercing crankcases with monotonous regularity leading not just to damaged engines and substantial repairs needed, but also to resulting engine fires which could and did cause severe damage to airframes and cost human lives.

The ill-fated Avro Manchester.

Few squadrons were supplied with Manchesters, in light of their appalling performance as a piece of military equipment. Those that were, suffered appalling losses and frequent groundings for modifications. No. 207 Squadron at Waddington in Lincolnshire, was the first to be equipped with the aircraft and over a period of just a few weeks, lost almost all its aircrews to the aircraft malfunctions and malperformance. Over all, Avro Manchesters served the RAF for just 21 months before being withdrawn from all operations. 202 aircraft had been delivered, and of these, 136 had been written off in combat or as a result of accidents. This horrendous casualty rate represents over 67% of the supplied aircraft being lost in operations.

SPECIFICATIONS:

Crew:	7.	Powerplant:	2 X 1760 hp Rolls-Royce Vulture engines
Max airspeed:	230 knots	Wing span:	27.46 m
Height:	5.94 m	Max. Weight:	22,680 kg

The Manchester with its original central tail fin

The dreaded Avro Manchester. It gave better service to the Germans than the British.

------ ooOOoo ------

Keeping up with the Play (Test yourself – how good are you, really?)

1. The propeller on a single aeroplane's nose turns anticlockwise from the cockpit. Which rudder is the pilot most likely need to hold during the climb to offset the slipstream effect?
   A. Either left or right rudder.
   B. No rudder.
   C. Left rudder
   D. Right rudder.

2. Two aircraft, 100 nm apart, are tracking true north (360°T). Will their tracks be parallel to each other if their compasses are without error?
   A. It depends on the amount of drift each aircraft is experiencing.
   B. Yes, their tracks will be parallel because they are both tracking 360°T.
   C. No, because they are both flying a meridian which diverges to the equator and converges from the equator to the true pole.
   D. Yes, but if they are flying to the destinations 100 nm apart.

3. Which of the following forecasts provides cloud bases and heights above ground level?
   A. GAF.
   B. METAR.
   C. GPW&T.
   D. TAF.

4. At what stage of flight does the aeroplane's lift have to exceed the aeroplane's weight?
   A. Pulling out of a dive.
   B. When in a banked turn.
   C. When in a steady climb.
   D. When in a steady glide.
   E. A and B are both correct.

5. Does "P" factor (aka asymmetric bladed effect) only affect an aeroplane during take-off?
   A. No, it will affect the aeroplane at any time it has high thrust and low airspeed, and is not moving in the direction in which the nose is pointing.
   B. Yes, it is only an issue on take-off.
   C. No, it affects the aeroplane at all times and speeds and uses a tail-fin offset to correct in cruise.
   D. A and C are both correct.

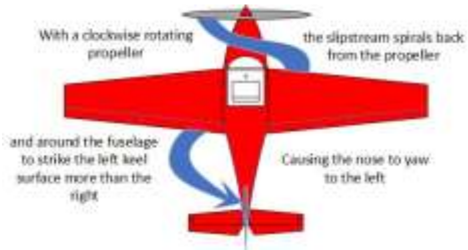
See answers and explanations overleaf.

If you have any problems with these questions, see notes below, or call me (in the evening) and let's discuss them. Rob Knight: 0400 89 3632 (International +61 4 0089 3632), or email me at kni.rob@bigpond.com.

1. C is correct.

As the sketch to the right displays, a clockwise rotating propeller will apply a force to the left side of the aircraft fin and keel surfaces pushing the tail right so the nose yaw left with high power & low airspeed.

Conversely, an ***anticlockwise rotating propeller*** will cause yaw to the right so ***left rudder*** will be require to counter it.



Slipstream effect with a clockwise rotating propeller.

2. C is correct.

When flying on any meridian, meridians diverge from pole to equator, and converge from equator to pole. Therefore, they cannot be flying parallel tracks.

3. D is correct.

TAF provide cloud bases and heights above aerodrome level for safe operations around that airfield. See http://www.bom.gov.au/aviation/data/education/taf.pdf

4. E is correct.

Only when an aeroplane is changing direction the lift will need to exceed the weight.

5. A is correct.

"P" factor will affect the aeroplane at any time it has high thrust and low airspeed, and is not moving in the direction in which the nose is pointing. Take-off is only one situation where it manifests itself.

------ ooOOoo ------

Aircraft Books, Parts, and Tools etc.

Contact Rob on mobile – 0400 89 3632

Tow Bars

Item	Condition	Price
Tailwheel tow bar.	Good condition	**$50.00**

Aircraft Magnetic Compass (Selling on behalf)

Item		Price
Magnetic compass: Top panel mount, needs topping up with baby oil.		**$45.00**

Propeller Parts

Item	Condition	Price
Propeller spacers, Assorted depths, all to fit Rotax 912 UL/ULS propeller flanges	Excellent	**$100.00 each**
Spinner and propeller backing plate to suit a Kiev, 3 blade propeller, on a Rotax 912 engine flange.	Excellent	**100.00**

For all items, Contact me - on mobile – 0400 89 3632

Or email me at:

kni.rob@bigpond.com

Aircraft for Sale

Kitset - Build it Yourself

$1,780.00 neg

DESCRIPTION

All of the major components needed to build your own aircraft similar to a Thruster, Cricket or MW5.

- Basic plans are included, also
- Hard to obtain 4" x 3" box section, 2 @ 4.5 metres long.
- Wing spar & lift strut material - 6 tubes of 28 dia. x 2 wall.
- 20 fibreglass ribs plus the moulds,
- 16 spar webs plus the moulds,
- 2 fibreglass flat sheets for the leading edges - 4 metres long x 1.1 metres wide.
- All instruments including,
- A Navman flow meter,
- A Powermate rectifier regulator,
- A ballistic parachute,
- A 4-point harness,
- Set fibreglass wheel pants, and
- More.

Box sections and tubes

Flow Meter, Navman, Ballistic Chute, etc

A very comprehensive kit of materials

Ribs, tubes, spats, etc

Colin Thorpe. Tel: LL **(07) 3200 1442**,

Or Mob: 0419 758 125

Thruster T85 Single Seater for sale.

$9,750.00 NEG

Beautiful classic ultralight single seater taildragger Thruster for sale; to good Pilot. Built in 1984, this is a reluctant sale as I inherited Skyranger V Max and two aeroplanes are too many for me.

The aircraft at Kentville

New Engine Rotax 503 Dual Ignition has only 10

Fuel tank

Instrument panel

Details

Built - 1991	Serial Number - 312
Model - Thruster 85 SG	Rego Number – 10-1312
TTIS Airframe - 638	Original logbooks - YES
Engine - *NEW* Rotax 503 DIUL	Next Annuals due – 05/11/2023
TTIS Engine – 10 hours	Propeller – Sweetapple, Wood, 2 Blades (as new)

Instruments - RPM, IAS, VSI, ALT, Hobbs meter, New Compass, CHTs, EGTs, Voltmeter & fuel pressure gauge

Avionics - Dittel Radio 720C and new David Clark H10-30

Aircraft is fitted with Hydraulic Brakes. Elevator Trim. Landing Light. Strobe Beacon. Auxiliary Electric Fuel Pump.is in excellent mechanical condition and the skins are “as new”.

<u>Offers considered. Call Tony on 0412 784 01</u>

Sky Dart Single Seat Ultralight for Sale.

$4,500.00 NEG

A single seat, ultralight, Taildragger. Built in 1987, this aircraft has had a single owner for the past 18 years, and is only now I am regretfully releasing it again for sale. I also have a Teenie II and am building another ultralight so I need the space.

The landed Sky Dart III rolling through at YFRH Forest Hill

TTIS airframe is 311 hours, and the engine, TTIS 312 – is just 1 hour more. Up-to-date logbooks available. 2 X 20 litres tank capacity. To be sold with new annuals completed.

It is easy to fly (for a taildragger), and a great way to accumulate cheap flying hours.

Call me to view, Bob Hyam, Telephone mobile 0418 786 496 or Landline – 07 5426 8983, or Email: bobhyam@gmail.com

Landed at McMaster Field after my flight back from Cooma just West of Canberra. In the cockpit with me is GeeBee, my dog

Single Seat T84 Thruster, disassembled and ready for rebuild.

I have a T84 single seat Thruster project in my hanger at Watts bridge.

The fuselage is on its undercarriage, the wing assemblies are folded up and the skins are with them.

Included is a fully rebuilt Rotax 503 dual ignition engine and propeller.

And, most importantly – the aircraft logbook!

Asking price $5000.00

Contact John Innes on **0417 643 610**

Slipstream Genesis for Sale

Slipstream Genesis. Built 2001. Two seats side by side, powered by 80 hp 912UL Rotax, driving a Warp Drive 3 bladed prop. Cruise 70-75 knots. Empty weight 304kg, MTOW 544 kg, Payload 240 kg. Fuel tanks hold 78 litres. With fuel burn averaging 16 litres/hr, still air endurance (nil reserve) is theoretically 5 hours, or 350 nm. Aircraft always hangered. It has been set up for stock control or mustering, and is not fitted with doors.

Registered until 13 October 2024, currently flying, and ready to fly away

Total Hours Airframe: 149.7. Current, up-to-date, logbook. Aircraft flying so these figures will change

Total Hours Engine: 1673.9. Annuals/100 hourly inspection due 07/06/2024. Sprag clutch replaced January 2020, gearbox overhauled January 2020. Just undergone ignition system overhaul. One CDI Ignition unit replaced PLUS brand-new spare unit included in sale. Easy aircraft to maintain - everything is in the open. Comes with spare main undercarriage legs, spare main wheel, and nosewheel with other assorted spare parts included. Sale also includes spare engine ready to fit (logbook available).

Fabric good, seats are good, interior is tidy. Fitted with XCOM radio/intercom. Basic VFR panel with appropriate engine instruments, and compass.

An article on this aircraft was published in Sport Pilot, June 2019 issue. See front cover and pilot report within.

Must sell: two aeroplanes are one too many. Quick sale - Fly it away for $10,000 including spare engine.

Contact **Rob Knight tel. +61 4 0089 3632**, **or email** kni.rob@bigpond.com for details and POH.

$10,000

Aircraft Engines for Sale

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