WAMASC Newsletter

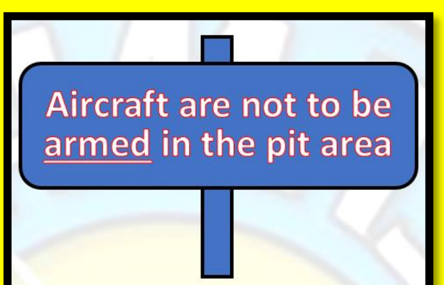
May 2021

Single-Blade Propeller

Contra Rotating Propellers

Message from the Editor

Rule Update/Change



should any individual have anything at all they would like to contribute, share, or add to this newsletter, please feel free to contact the ***editor*** *through the* ***Club Secretary*** *via ✉ **secretary@wamasc.com.au** – enjoy*

Single-Blade Propeller

Prior to a very recent General Meeting, I spoke with a couple of our ‘**control-line**’ flyers who were in attendance and asked the question if it was still standard and common practice for them to make use of **single-bladed propeller**(s)? The unequivocal answer was in the affirmative – however; I was met with strange glances and puzzled looks from some who were listening in on the conversation. It is for this reason, and after being asked, I now reiterate a previous article that I penned in a previous Newsletter some years ago.

Experiments with a One Blade Propeller came about during WWI with the requirement to fire through a propeller arc

To be specifically correct; the **One Blade** or **Single-bladed propeller assembly** had its origins in WWI.

Apart from the other myriad forms of propulsion seen and used in aviation now days, the propeller is the heart and soul of our sport, aeromodelling. They allow us to achieve flight either by pushing or pulling our aircraft through the air thus propelling it toward the heavens giving much enjoyment to the pilot.

The application of a One Blade propeller, or a Single-bladed propeller assembly is not known to all and often draws puzzled looks of astonishment and amazement when seen (which is not that often).

As mentioned, it is often used in ‘**Control-Line Flying**’. In fact, the fitment of a single-blade propeller assembly within aeromodelling circles has been the norm for many years. The reason(s) for this type of fitment are numerous but are mainly reliant on the application and specific requirements of the aircraft. The old adage of ‘horses for courses’ applies but it is the reason that all aircraft are fitted with their own specific type of propeller assembly which may suit only that individual aircraft.

Contrary to many beliefs’ a single-blade propeller does not have a a problem or issue generating thrust. It is just less efficient than its two-blade counterpart, just as a two-blade is less efficient than a three-blade and so on (some would argue this point as there certainly comes a time when the addition of blades becomes ineffective).

But that is exactly the issue and point. Just think – should you fit an over size propeller to an engine (incorrect pitch or length), that engine will bog down and have trouble turning the propeller hence it will not be able to attain its optimum or maximum rev limit. In fact, it may perform underpowered; one must match a propeller to the engine's capability.

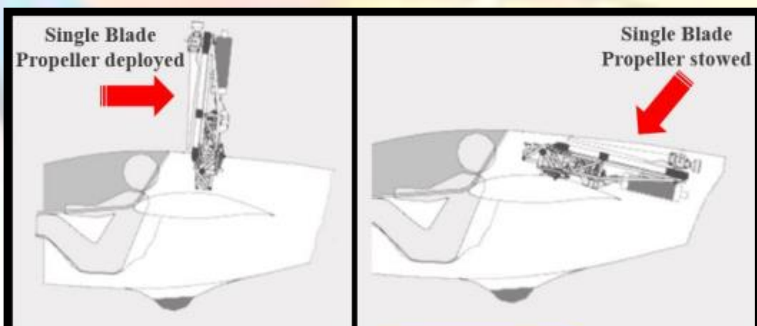
In the real world of aviation, you can and will see engines fitted with multibladed propeller assemblies that defy the imagination. What allows that is the engine behind it and the amount of '**shaft horsepower**' being generated.

The fact is a one blade propeller actually develops less vibration than any other multiblade propeller assembly with the added bonus of creating less engine stress and wear than its counterpart. This is the main reason single-blade propellers are used in control-line flying as they allow *small scale aircraft* fitted with *small bore capacity engines* the ability to reach their maximum peak rev limits more easily and quickly.

This is, of course, due to less resistance being imparted on only one blade cutting through the air (a multibladed propeller will always find it a harder task having to push more material through viscous air). The added bonus for a single blade propeller is that it can increase engine fuel efficiency as long as that engine does not over rev (remember a propeller will become inefficient and not push air should any part of it be allowed to travel past, or exceed, 1234.8 Km/H (the speed of sound)).

Now it is true that outside of aeromodelling propellers are normally multibladed. A point of fact is that Single bladed propellers are principally used to fulfil engineering requirements that fall outside the scope of efficiency.

A prime example of this is when using a motorized glider. The simplicity of a single-blade propeller fits well as it permits the design of a smaller aperture in the glider's fuselage for the retraction of the **pop-up powerplant**.



Motorized Glider making use of Single Blade Propeller application

It also creates less drag when that single blade is stowed in-line with the engine mast.

It is worth noting that single blade propellers are usually of a **fixed** pitch design and cannot be feathered into airflow.

Motorized gliders used in aeromodelling are normally fitted with a hinged propeller that can fold and deploy when power is supplied.

This is not to say that a **single-bladed propeller assembly** has not ever been used on a larger scale aircraft – it has. Circa 1914, with the advent of WWI, the Airplane was less than eleven years old. Aviation was a fledgling technology that fascinated many but still generated scepticism when it came to practical applications.

Out of necessity the airplane had to be fitted with armament for war purposes. The practice of carrying a revolver and firing at enemy from the cockpit was ludicrous; especially if that enemy was airborne. A comedy of errors ensued with much trial and error. Firstly weapons (guns) were fitted ahead of the pilot who simply fired off a multitude of rounds through his own propeller arc to down an enemy aircraft – unfortunately not a good practice if it's your own aircraft that you shoot down.

In a leap of ingenuity ***deflectors*** were fitted to the rear of propeller blades to circumnavigate the problem. This caused further problems as it changed the aerodynamic properties of the propeller causing power loss.

The one blade propeller (single-bladed propeller assembly) made its entrance at this time giving more time to fire between the travelling blade.

A better solution was still required and finally solved in mid 1915 when a Dutch aeronautical engineer and aircraft designer named **Anton FOKKER** developed the '**interrupter gear**' – a timing mechanism that synchronized the machine gun with the moving propeller blades.

On the 01st of August 1915, German pilots, **Oswald BOELCKE** (who penned axioms for individual pilot success in the '**Boelcke Dicta**' – the Air Fighting Tactics still used to this present day) and **Max IMMELMANN** (yes – that '**Immelmann manoeuvre**' is named after him) became the first pilots to shoot down another aircraft using FOKKER's new method.

This development gave the Germans a strong advantage for several months until **French** and **British** designers succeeded in adapting the device for their own use about one year later.

The single-blade propeller was born from the seeds of war, its origin coming from an innovative thought process that was exacerbated in a time of crisis and need.

The **single-bladed propeller assembly** still has its uses all beit unsuitable for many applications in today's modern aviation environment. It certainly will never be used in large scale commercial application using turbo prop engines. Those engines and the requirements for constant speed variable pitch propellers capable of producing large thrust volume negate the fact that a single blade could ever be more efficient than its multiple blade counterpart(s). It is true to say that a single blade (one blade propeller) is always travelling through undisturbed air making it an extremely efficient piece of kit – for what it is.

As stated above, the simple fact is large powerful engines can afford to drive multibladed propeller systems regardless of disturbed air efficiency loss. They overcome this by grabbing as much air as possible using a lot of muscle, something a single-blade propeller cannot possibly do.

It is, however, worth noting that in 1939 the manufacturers of **Everel Propellers** tested a one blade propeller system on a **Taylorcraft J-2 Cub** which they entered in a race and won by an extremely large margin.

Flight tests indicated and gave evidence supporting the Cub's new astonishing performance parameters which had increased remarkably.

It was now capable of a faster rate of climb and had a higher cruising speed.

Fuel efficiency had increased giving a much greater flight endurance and range.

Unfortunately, their elation was

very short lived with the introduction of a more powerful and lighter 50HP power plant (engine) that had been developed for the same aircraft. That engine derivative hit the market and rendered the efficiency gains of their single-blade propeller assembly moot almost overnight.

Also, to be taken into account and consideration was that the **balance** of a one blade propeller system was a very fickle thing indeed – especially in changing weather conditions.

That is to say that ambient temperature was noted to affect a one blade propeller system enormously.

The thermionic expansion coefficients (expansion and contraction rates) experienced throughout blade material over the long arm of a blade on only one side of a hub proved extremely temperamental with differing altitude. The continual temperature changes at differing altitude caused frequent balance loss. The propeller just wasn't worth the effort, so the design never caught on.

It is and always will be a nifty bit of engineering. It is a cool piece of history that has now been relegated for use mainly in our sport of aeromodelling.

Contra Rotating Propeller

I would like to remain true to the theme of propellers for just a little longer and make mention of another very unique type of propeller assembly system and pass on a little information.

Many aircraft encountered in the real world of aviation can be fitted and/or equipped with Constant Speed, Variable pitch, propellers – these propeller assemblies may be fitted with a multitude of blades. They may also be configured as a **CRP** (**Contra Rotating Propeller**(s)) system – that is one propeller assembly directly behind another turning (rotating) in opposite direction to its counterpart.

Firstly, let's get our head around what is meant by a **constant speed propeller** or more correctly system.

A constant speed propeller is designed to automatically change its blade pitch angle allowing it to maintain a constant RPM, irrespective of the amount of engine torque being produced or the airspeed or altitude at which the aircraft is flying. This allows an aircraft to run its engine(s) at 100% and remain stationary without its propeller(s) moving air until the blade pitch angles are altered to a higher AoA. (this is referred to as 'feathering' and may be used when an aircraft engine is shut down during flight which is referred to as 'loitering').

During flight while cruising blade pitch angles will change automatically to maintain constant RPM and enhance both fuel efficiency and propulsion. A **Contra Rotating Propeller** is also often referred to as **Coaxial Contra Rotating Propeller** – these high-speed propellers are used to apply the maximum power of usually a multi-piston or turboprop engine to drive two coaxial propellers in contra-rotation (rotation about the same axis in opposite directions).

The main advantage to a contra-rotating propeller is the efficiency gained from the trailing propeller as it is turning in air that has been redirected by the front propeller from straight to a beneficial angle of attack to the trailing propeller.

There is also a newly discovered benefit for a CRP system; should the trailing propeller assembly have a different number of blades (more or fewer – it does not matter) than the front propeller assembly, it has the effect of cancelling out a lot of turbulence and resonant noise at the correct cruising RPM and Speed.

Contra Rotating Propellers by default are usually extremely noisy hence do not suit the application of passenger carriage due to EPA regulations. Commercial carriers have trialled their usage in the past due to promised efficiency gains but stopped short due to noise restriction problems.

Contra-rotating propellers have a huge benefit, almost outweighed by their complexity. They cancel out torque turn, thrust and twist.

A normal one directional rotating blade places disadvantages to a propeller driven aircraft as it will turn better one way as opposed to the other due to directional torque loading as the propeller fights against the intended directional change of the aircraft.

Rule Update/Change

Monday the 19th of April 2021 saw an e-mail from the WAMASC Secretary disseminated to all members noting the amendments and changes to our **WAMASC Safety & Procedures Manual** that were ratified at our last GM.

As penned by the Secretary some domestic changes were necessary, and the new Electric rules have been included.

The WAMASC Safety & Procedures Manual may be navigated to via the following link below:

https://www.wamasc.com.au/safety-procedures-manual

In particular reference is given to the rewording, for total clarity, of the ruling of how we **arm** electric aircraft.

I reiterate that this task is to be strictly adhered too and followed in conjunction with the **Model Aeronautical Association of Australia Inc MOP056 – Safe Flying Code** which may be navigated to via the following link:

https://www.maaa.asn.au/images/pdfs/mops/MOP056-Policy-SAFE-FLYING-CODE.pdf

An aircraft is deemed '**armed**', regardless of other fitted **fail-safe devices** once the battery has been connected.

Directly extracted from the WAMASC Safety & Procedures Manual; it now reads verbatim:

Electric Models Starting Procedures

Before connecting the flight battery to the speed controller, the following steps are to be followed.

1. carry the model from the pit area and place on a starting stand or hardstand, with the propeller facing away from the pits.

2. Secure the model with the help of another member. If flying by yourself endeavour to safely secure the model prior to starting.

3. Turn transmitter on set at low throttle.

4. Connect the flight battery to the speed controller from behind the propeller arc.

5. Check that the propeller rotation is correct before moving to the flight line.

6. After the flight disconnect the flight battery from the speed controller prior to entering the pits.

7. These steps are to be followed regardless of the number of isolating switches fitted to the model.

One is reminded that no aircraft are to be armed within the pit area and that all aircraft must face away from the public and outward of the pit area at all times.

Message from the Editor

The 23rd of May 2021 caught many of us off guard and unawares as we once again were plunged back into a mini lockdown over the **ANZAC long W/E**.

Evidently, we were not done with wearing PPE, and for those of us who had thrown out their masks it was back to the chemist or shop for a quick purchase.

The vaccine(s) implementation against COVID-19 is extremely slow with many now pondering the pros and cons of getting the **AstraZeneca** shot due to the reports of 'blood clotting'. A problem that has slowed the role-out of the vaccine even more – not including the fact that there isn't any supplies (one could be forgiven for thinking that we reside in a TCN).

What has been amplified with the recent lockdown is the absolute necessity for **contact tracing**. Should we fail in this area and have a real breakout – then we are in dire straits.

I implore you to remain diligent and not become complacent and ask you all to please scan the QR Code on arrival at the Field.

"Man must rise above the Earth – to the top of the atmosphere and beyond – for only thus will he fully understand the world in which he lives".

Socrates