WAMASC NEWS

FEBRUARY 2015

NEWSLETTER

This is your Newsletter and I once again reiterate; should any individual have anything that they would like to contribute, please don't be shy – feel free to contact any of the committee or contact me directly at: michael.wayne.cuerden@gmail.com

MEMBERSHIP

We have had quite an influx of new members in the last month and we would like to extend a hearty welcome to our new WAMASC brethren. Welcome to the club folks and have fun.

As always membership forms are available on our website at: http://www.wamasc.org.au/membership.html.

SAFE FLYING

Please remember to lock up if you are last to leave

GFDI AND WHAT IT MEANS TO YOU

GFDI (Grassland Fuel Dryness Index or Grass Fire Danger Index), **FDI** (Fire Danger Index) and **FFDI** (Forest Fire Danger Index) are all wonderful acronyms that may confuse some – however they all basically mean the same and give reference to the Fire Danger Level or threat.

With this in mind please be aware that the WAMASC field may be arbitrarily closed to all activity by the **City of Swan/Whiteman Park Management** at extremely short notice during the summer months regardless of **GFDI** status as issued by the **BOM** (Bureau of Meteorology) or Total Fire Bans issued by **DFES** (Department of Fire and Emergency Services). Furthermore; **Whiteman Park Management** reserve the right too close the field at any time regardless of **GFDI** status and have, on the odd occasion, exercised this right when it is low.

It is only a courtesy that the committee sends an E-mail to all members when informed or aware of a field closure brought on by high **GFDI**. This is a hard task when not included in any decision making process'.

The **BOM** issue Fire Weather Warnings when weather conditions are conducive to the spread of dangerous bushfires. Warnings are generally issued within 24 hours of the potential onset of hazardous conditions. I emphasise that the onus is on the individual and strongly suggest that prior to leaving home it would be wise to first look up the **BOM GFDI** and establish that the **GFDI** is equal to or above 40, then call **Whiteman Park** directly on **(08)92096000** to enquire as to the actual status. Then contact the **City of Swan** recorded seasonal bans latest updates on **(08)9267 9326**.

Some useful and relative information to assist you

Total Fire Bans: Please note that the Bureau of Meteorology **does not** have the power to declare a Total Fire Ban. This responsibility resides with the designated fire agencies in each State and Territory.

The **WAMASC field** is always closed by the **Whiteman Park Management** on days when the **GFDI** for the **Lower West Coast** equals or exceeds 40.

Whiteman Park Management will automatically close the field if the **City of Swan** issue a **Harvest & Movement Ban** or **DFES** issue a **Total Fire Ban** for the area.

Note: The **City of Swan** Website may have some information with regard to the **Harvest & Movement Bans** they impose, but should not be relied upon for information with regard to WAMASC field closure (remember Whiteman Park Management may close even if the index is low). At this point in time the **Whiteman Park** Website contains no information regarding park closure and information is only attainable should you be fortunate enough to make contact with Management Staff. Due to this the **BOM** and **DFES** websites cannot be relied on when it comes to anticipating WAMASC field closures hence a coordination between all sites must be adhered too when making a decision prior to an outing.

In 2009 the Extreme category was divided into three levels **- Severe**, **Extreme** and **Catastrophic**. These index ranges were common for both the **FFDI** (Forest Fire Danger Index) and the **GFDI** (Grass Fire Danger Index). In October 2010, fire agencies adopted a revised scale for some areas. Within the modified arrangements, there are different ranges for the grass and forest indices.

Because a single range of index values no longer correspond to the danger ratings of Severe, Extreme and Catastrophic (Code Red), the Bureau will indicate the **FDR** (Fire Danger Rating) Category without reference to the **FDI** (Fire Danger Index). For example "Extreme: FDR 75 to 99" will now be shown as "Extreme". You will observe an **FDR Colour Board** on entry to the WAMASC field when exiting Beechboro Rd Nth.

FIRE DANGER RATING
Category
CATASTROPHIC (CODE RED)
EXTREME
SEVERE
VERY HIGH
HIGH
LOW – MODERATE

For ease of accessing information please find some helpful links below:

- http://www.wamasc.org.au/weatherlinks.html
- http://www.bom.gov.au/wa/forecasts/fire-southwest.shtml
- **BOM Fire Weather Forecast (Check the Lower West Coast)**
- **DFES Total Fire Bans**
- **City of Swan**
- **DFES**
- **BOM**
- **Current Metropolitan Area Weather Forecast**
- **Whiteman Current Weather Conditions**
- **Current Weather Conditions for the Perth Region**
- **Western Australian Forecasts**

NEW WAMASC WEBSITE ON-LINE

Our new modernised Website is now on-line and has been made very 'user friendly' with easy access to multiple links and information.

It is a free Website readily accessible to both the public and WAMASC members alike.

Nothing has changed with regard to accessing the new Website as the old WAMASC Home Page address (**www.wamasc.org.au**) has been redirected and will automatically send you to the new free WiX Site at **http://wamasc.wix.com/wamasc**.

Upon entry WAMASC members may access relevant information by entering through the **Members Area** button (shown below denoted by **red** circle).

Simply hover your cursor over the **Members Area** button (it will turn yellow) and a 'Password' window will appear – simply enter your code and 'click' or 'press' enter.

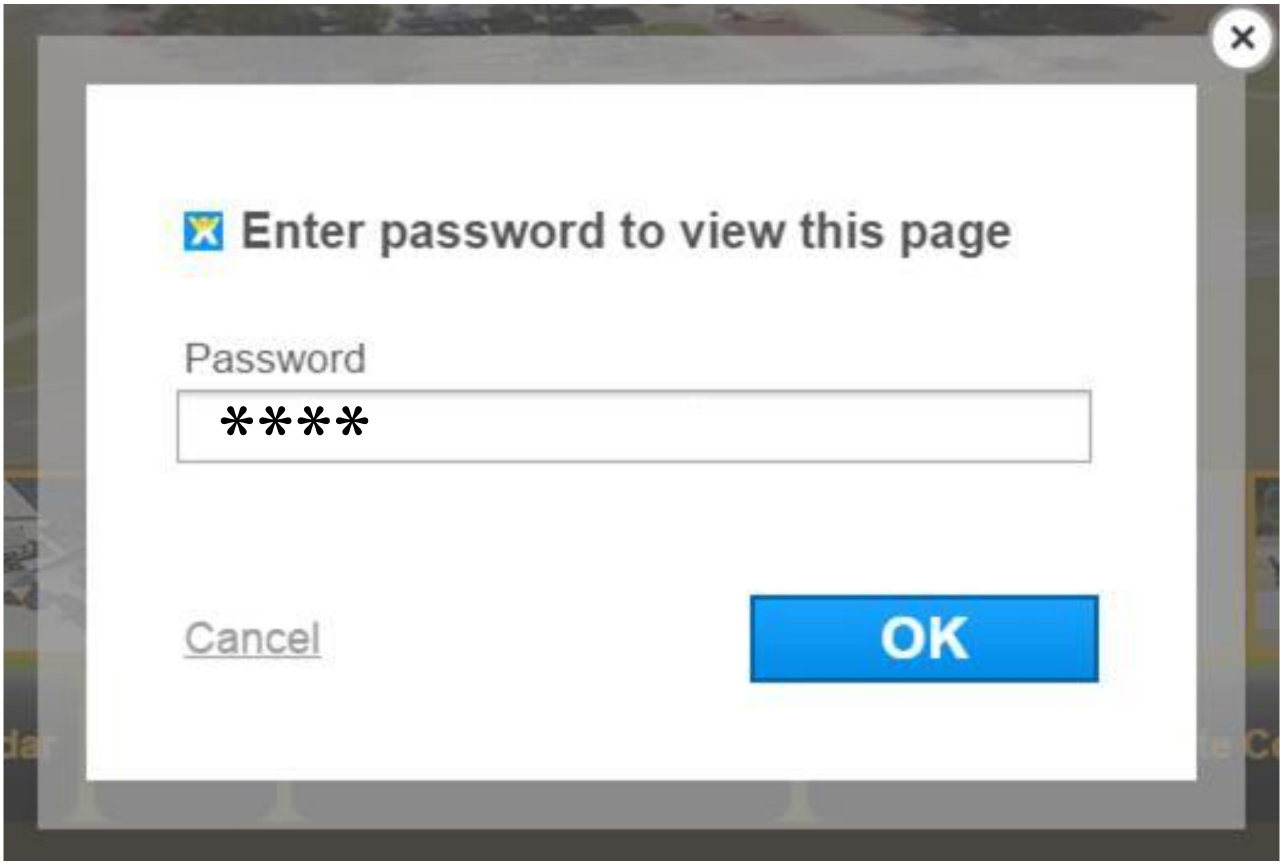
Access is achieved using your WAMASC field access code (the four (4) digit number found on the reverse of your membership card).

Note: The **Technical Area** found when navigating the **Members Area** may be accessed without the use of a code.

Should you have any questions accessing information please do not hesitate to contact me via: ☎ Mob: 0414402193 or ✉ **michael.wayne.cuerden@gmail.com**.

New WAAMASC Website

Password window
Found post navigating the Members Area button



BASIC PROPELLER PRINCIPLES

An aircraft propeller consists of two or more blades and a central hub to which the blades are attached.

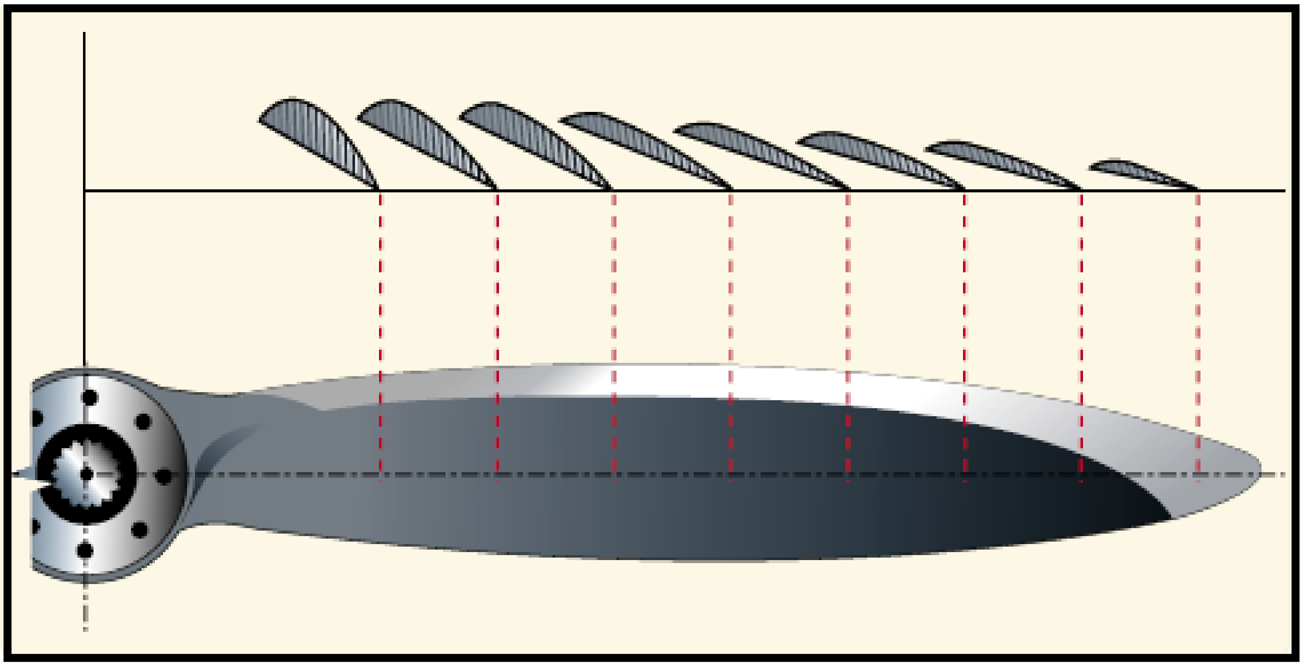
Each blade of an aircraft propeller is essentially a rotating wing. As a result of their construction, a propeller blade is much like an aerofoil and produce forces that create the thrust to pull, or push, an aircraft through the air. The engine furnishes the power needed to rotate the propeller blades through the air at high speed(s), and the propeller transforms the rotary power of the engine into forward thrust.

A cross-sectional view of a typical propeller blade is shown on the next page. This section or blade element is an aerofoil comparable to the cross-section of an aircraft lift-wing.

One surface of the blade is cambered or curved, similar to the upper surface of an aircraft lift-wing, while the other surface is flat like the bottom surface of an aircraft lift-wing.

The chord line is an imaginary line drawn through the blade from its leading edge to its trailing edge. As in a wing, the leading edge is the thick edge of the blade that meets the air as the propeller rotates.

You will also note that when viewing the propeller that the closer to the central hub the more pronounced the pitch. This is because in relation to the outer tip of the blade the centre travels at a slower speed hence a greater pitch angle is required to maintain an even thrust across its entire length.



Blade angle, usually measured in degrees, is the angle between the **chord of the blade** and the **plane of rotation** and is measured at a specific point along the length of the blade. Because most propellers have a flat blade "face," the chord line is often drawn along the face of the propeller blade. Pitch <u>is not</u> blade angle, but because pitch is largely determined by blade angle, the two terms are often used interchangeably. An increase or decrease in one is usually associated with an increase or decrease in the other.

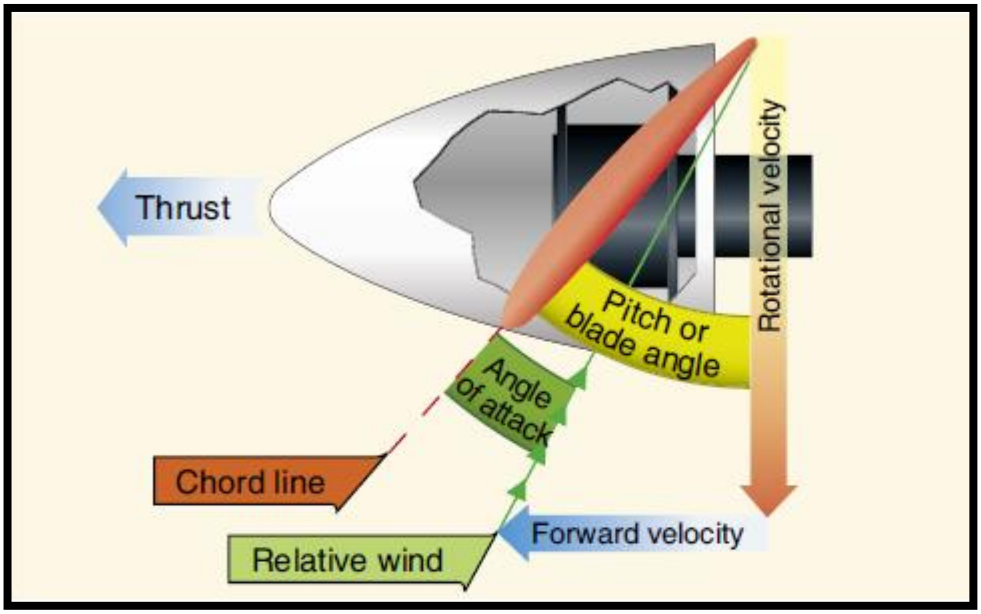
The pitch of a propeller may be designated in inches. A propeller designated as a "74-48" would be 74 inches in length and have an effective pitch of 48 inches. The pitch is the distance in inches, which the propeller would screw through the air in one revolution if there were no slippage.

When specifying a fixed-pitch propeller for a new type of aircraft, the manufacturer usually selects one with a pitch that operates efficiently at the expected cruising speed of the aircraft. Every fixed-pitch propeller must be a compromise because it can be efficient at only a given combination of airspeed and RPM – a Pilot cannot change this combination in flight.

When that aircraft is at rest on the ground with its engine operating, or moving slowly at the beginning of take-off, the propeller efficiency is very low because the propeller is restrained from advancing with sufficient speed to permit its fixed-pitch blades to reach their full efficiency. In this situation, each propeller blade is turning through the air at an AOA that produces relatively little thrust for the amount of power required to turn it.

To understand the action of a propeller, consider first its motion, which is both rotational and forward. As shown by the vectors of propeller forces (shown below), each section of a propeller blade moves downward and forward. The angle at which this air (relative wind) strikes the propeller blade is its AOA.

The air deflection produced by this angle causes the dynamic pressure at the engine side of the propeller blade to be greater than atmospheric pressure, thus creating thrust.



The shape of the blade also creates thrust because it is cambered like the aerofoil shape of a wing. As the air flows past the propeller, the pressure on one side is less than that on the other. As in a wing, a reaction force is produced in the direction of the lesser pressure. The airflow over the wing has less pressure, and the force (lift) is upward. In the case of the propeller, which is mounted in a vertical instead of a horizontal plane, the area of decreased pressure is in front of the propeller, and the force (thrust) is in a forward direction. Aerodynamically, thrust is the result of the propeller shape and the AOA of the blade.

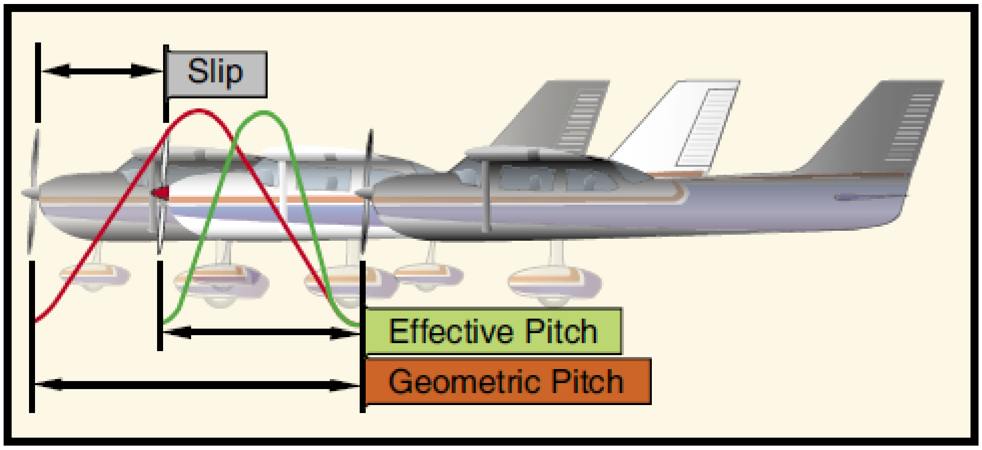
Thrust can be considered also in terms of the mass of air handled by the propeller. In these terms, thrust equals mass of air handled multiplied by slipstream velocity minus velocity of the aircraft. The power expended in producing thrust depends on the rate of air mass movement. On average, thrust constitutes approximately 80 percent of the torque (total horsepower absorbed by the propeller). The other 20 percent is lost in friction and slippage. For any speed of rotation, the horsepower absorbed by the propeller balances the horsepower delivered by the engine. For any single revolution of the propeller, the amount of air handled depends on the blade angle, which determines how big a “bite” of air the propeller takes. Thus, the blade angle is an excellent means of adjusting the load on the propeller to control the engine rpm.

The blade angle is also an excellent method of adjusting the AOA of the propeller. On constant-speed propellers, the blade angle must be adjusted to provide the most efficient AOA at all engine and aircraft speeds. Lift versus drag curves, which are drawn for propellers, as well as wings, indicate that the most efficient AOA is small, varying from +2° to +4°. The actual blade angle necessary to maintain this small AOA varies with the forward speed of the aircraft.

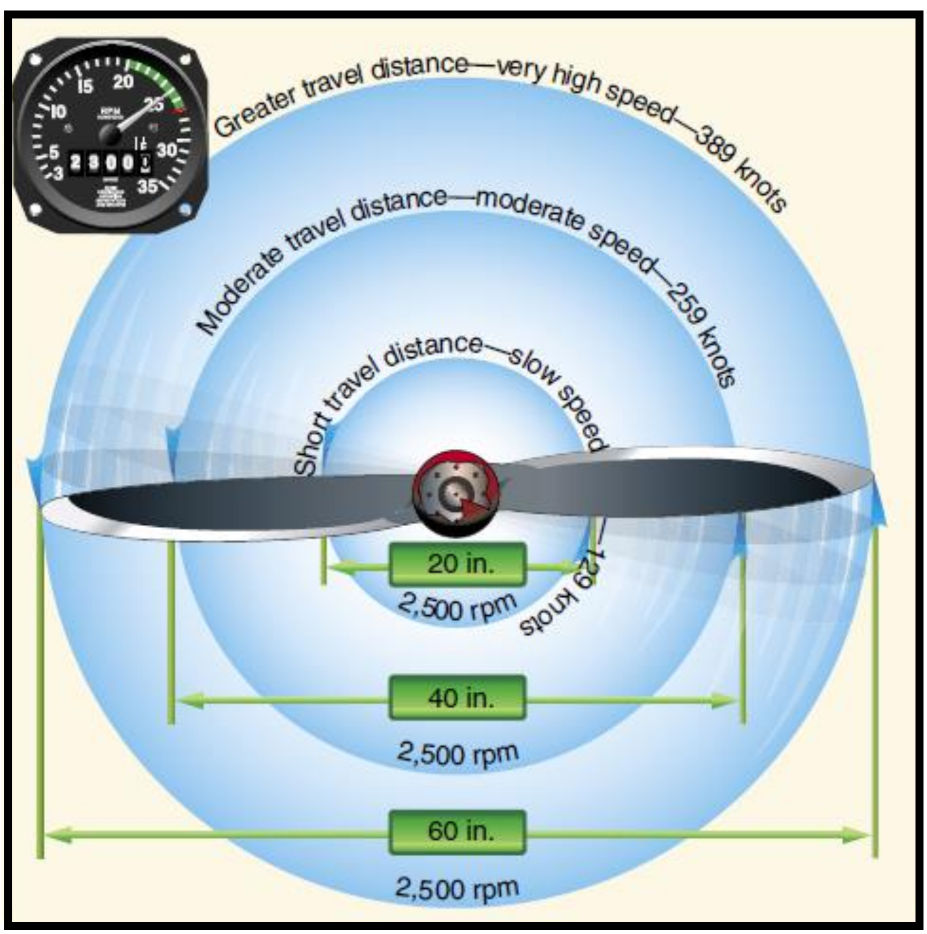
Fixed-pitch and ground-adjustable propellers are designed for best efficiency at one rotation and forward speed. They are designed for a given aircraft and engine combination. A propeller may be used that provides the maximum efficiency for take-off, climb, cruise, or high-speed flight. Any change in these conditions results in lowering the efficiency of both the propeller and the engine.

Since the efficiency of any machine is the ratio of the useful power output to the actual power input, propeller efficiency is the ratio of thrust horsepower to brake horsepower. Propeller efficiency varies from 50 to 87 percent, depending on how much the propeller “slips.”

Propeller slip is the difference between the geometric pitch of the propeller and its effective pitch. Geometric pitch is the theoretical distance a propeller should advance in one revolution; effective pitch is the distance it actually advances. Thus, geometric or theoretical pitch is based on no slippage, but actual or effective pitch includes propeller slippage in the air (refer below).



As previously mentioned Propeller tips travel faster than the internal hub and it is for this reason a propeller is “twisted” - the outer parts of the propeller blades, like all things that turn about a central point, travel faster than the portions near the hub. If the blades had the same geometric pitch throughout their lengths, portions near the hub could have negative AOAs while the propeller tips would be stalled at cruise speed. Twisting or variations in the geometric pitch of the blades permits the propeller to operate with a relatively constant AOA along its length when in cruising flight. Propeller blades are twisted to change the blade angle in proportion to the differences in speed of rotation along the length of the propeller, keeping thrust more nearly equalized along their length.



Usually 1° to 4° provides the most efficient lift/drag ratio, but in flight the propeller AOA of a **fixed-pitch propeller** varies—normally from 0° to 15°. This variation is caused by changes in the relative airstream, which in turn results from changes in aircraft speed. Thus, propeller AOA is the product of two motions: propeller rotation about its axis and its forward motion.

A **constant-speed propeller** automatically keeps the blade angle adjusted for maximum efficiency for most conditions encountered in flight.

During take-off, when maximum power and thrust are required, the constant-speed propeller is at a low propeller blade angle or pitch. The low blade angle keeps the AOA small and efficient with respect to the relative wind. At the same time, it allows the propeller to handle a smaller mass of air per revolution. This light load allows the engine to turn at high rpm and to convert the maximum amount of fuel into heat energy in a given time. The high rpm also creates maximum thrust because, although the mass of air handled per revolution is small, the rpm and slipstream velocity are high, and with the low aircraft speed, there is maximum thrust.

After lift-off, as the speed of the aircraft increases, the constant-speed propeller automatically changes to a higher angle (or pitch). Again, the higher blade angle keeps the AOA small and efficient with respect to the relative wind. The higher blade angle increases the mass of air handled per revolution. This decreases the engine rpm, reducing fuel consumption and engine wear, and keeps thrust at a maximum.

After the take-off climb is established in an aircraft having a controllable-pitch propeller, the pilot reduces the power output of the engine to climb power by first decreasing the manifold pressure and then increasing the blade angle to lower the rpm.

At cruising altitude, when the aircraft is in level flight and less power is required than is used in take-off or climb, the pilot again reduces engine power by reducing the manifold pressure and then increasing the blade angle to decrease the rpm.

Again, this provides a torque requirement to match the reduced engine power.

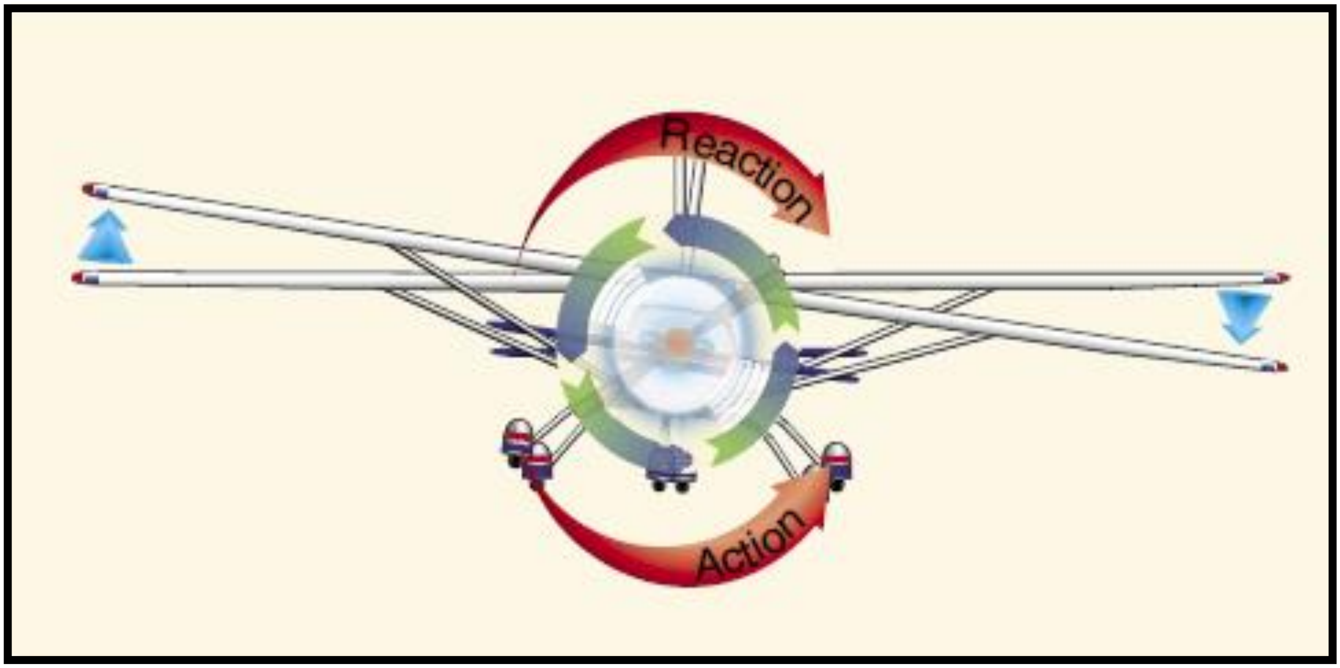
Although the mass of air handled per revolution is greater, it is more than offset by a decrease in slipstream velocity and an increase in airspeed. The AOA is still small because the blade angle has been increased with an increase in airspeed.

To the pilot, "torque" (the left turning tendency of an airplane) is made up of four elements which cause or produce a twisting or rotating motion around at least one of the airplane's three axes. These four elements are:

- **Torque reaction** from engine and propeller,
- **Corkscrewing effect** of the slipstream,
- **Gyroscopic action** (**procession** causing **precession**) of the propeller, and
- **Asymmetric loading** of the propeller (commonly referred to as **P-factor**).

We have covered most of the above topics in previous Newsletter articles without really speaking about this **torque reaction** which involves *Newton's Third Law of Physics* – 'for every action, there is an equal and opposite reaction'.

As applied to the aircraft, this means that as the internal engine parts and propeller are revolving in one direction, an equal force is trying to rotate the aircraft in the opposite direction (refer to diagram on next page).



We don’t really notice it on the ground with the aircraft stationary or even taxing as this reaction is cancelled by our undercarriage that is firmly planted and attached to terra firma thus transferring and absorbing the reactive load.

However; when that aircraft is airborne, this force is acting around its longitudinal axis, tending to make the aircraft roll. To compensate for roll tendency, some of the older aircraft are rigged in a manner to create more lift on the wing that is being forced downward. The more modern aircraft are designed with the engine slightly offset to counteract this effect of torque – just like your model.

NOTE: Most aircraft engines rotate the propeller clockwise, as viewed from the pilot’s seat. The discussion here is with reference to these engines.

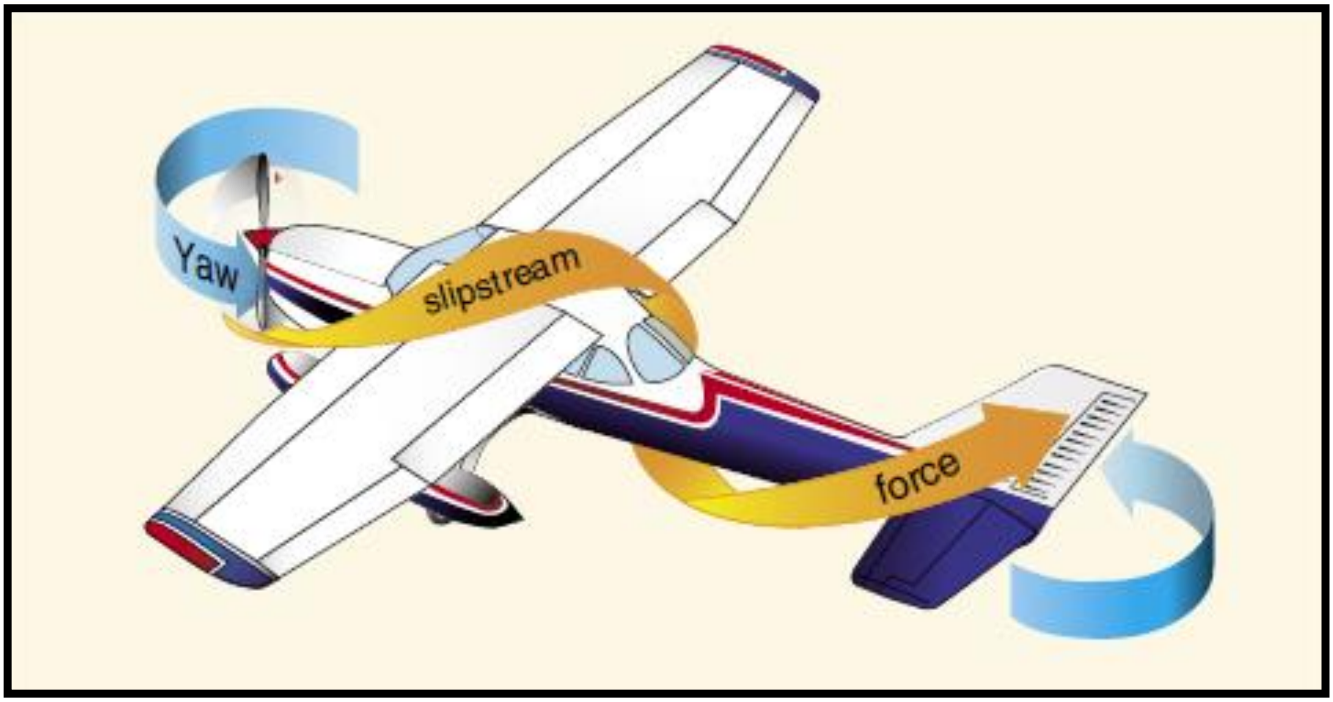
Generally, the compensating factors are permanently set so that they compensate for this force at cruising speed, since most of the aircraft’s operating lift is at that speed. However, aileron trim tabs permit further adjustment for other speeds.

When the aircraft’s wheels are on the ground during the take-off roll, an additional turning moment around the vertical axis is induced by torque reaction.

As the left side of the aircraft is being forced down by torque reaction, more weight is being placed on the left main landing gear. This results in more ground friction, or drag, on the left tire than on the right, causing a further turning moment to the left. The magnitude of this moment is dependent on many variables. Some of these variables are:

- Size and horsepower of engine,
- Size of propeller and the rpm,
- Size of the aircraft, and
- Condition of the ground surface (static and rolling friction).

This yawing moment on the take-off roll is corrected by the pilot’s proper use of the rudder or rudder trim.



The high-speed rotation of an aircraft propeller gives a corkscrew or spiralling rotation to the slipstream. At high propeller speeds and low forward speed (as in the take-offs and approaches to power-on stalls), this spiralling rotation is very compact and exerts a strong sideward force on the aircraft's vertical tail surface (please refer to **Corkscrew Effect** above).

When this spiralling slipstream strikes the vertical fin it causes a turning moment about the aircraft's vertical axis. The more compact the spiral, the more prominent this force is.

As the forward speed increases, however, the spiral elongates and becomes less effective. The corkscrew flow of the slipstream also causes a rolling moment around the longitudinal axis.

Note that this rolling moment caused by the corkscrew flow of the slipstream is to the right, while the rolling moment caused by torque reaction is to the left—in effect one may be counteracting the other.

However, these forces vary greatly and it is the pilot's responsibility to apply proper corrective action by use of the flight controls at all times. These forces must be counteracted regardless of which is the most prominent at the time.

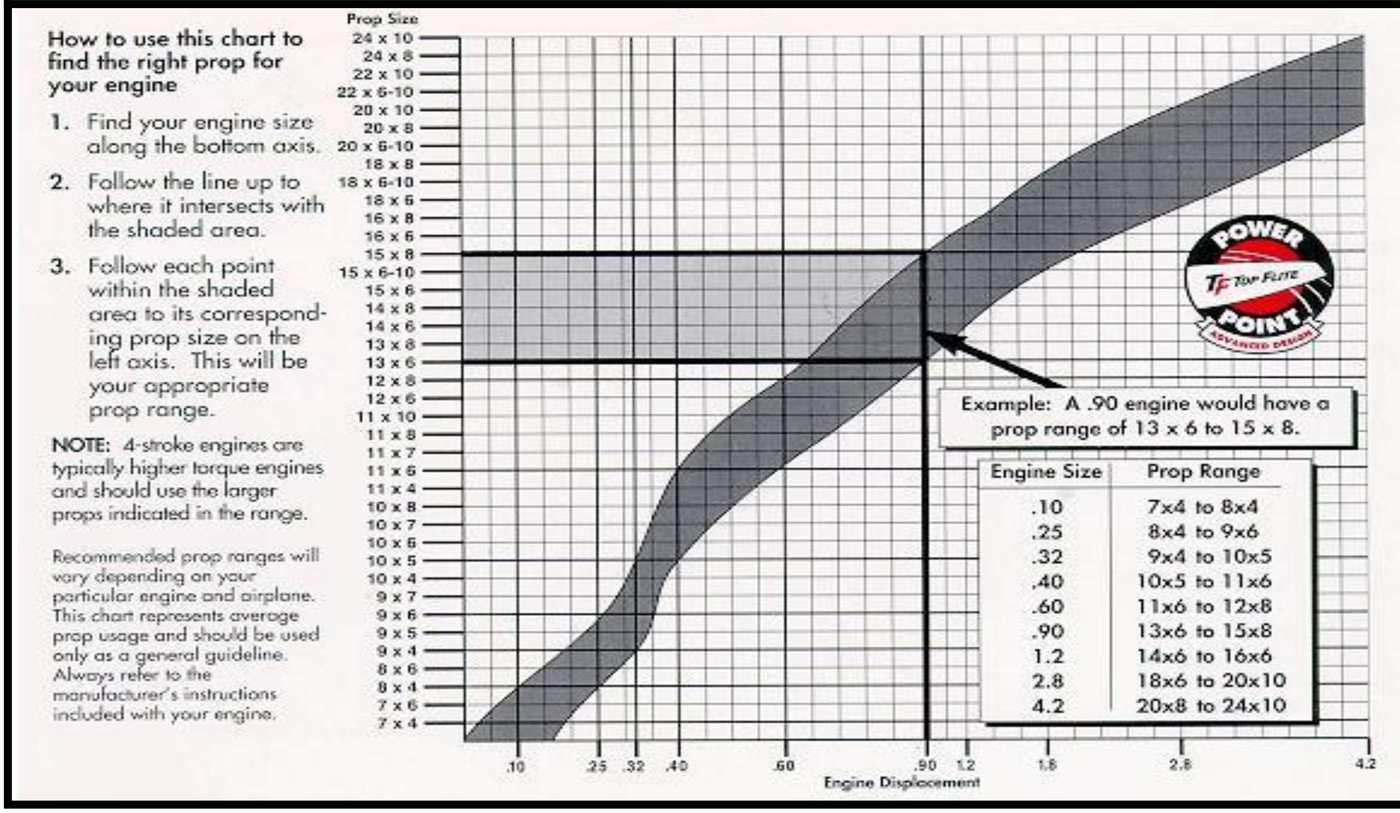
NOTE: Remember that just like an aerofoil (lift-wing) any part of a propeller that exceeds the speed of sound (340.29m/Second or 671.207051MPH at sea level dependant on ambient t°) <u>will not</u> push air.

This is one of the governing factors that define a propellers length when matching it to an aircraft.

It is also the reason why we have to factor in the theory of flight, in particular lift, as physics change above certain speeds with low pressure areas becoming high and vice versa. This is also the reason why ram air entering a jet intake cannot be allowed above the speed of sound no matter the speed of the aircraft as it will cause **surge** – the compressor and turbine blades having the very same cross sectional characteristics of a wing or propeller.

In our next article I will cover jet engine theory and talk further about **surge** and **stall**.

Please use this chart to assist matching your propeller size to your engine remembering that the best source of information is the relevant engine manual.



WAMASC SECURITY

Previous mention regarding 'Field Security' was addressed in the **2014 September** issue of the **WAMASC Newsletter**. Unfortunately this topic must now be revisited due to the ongoing frequency of recent breaches.

All members are politely reminded that **SECURITY** is the responsibility of each and every individual and that unless certain protocol(s) are adhered too we may find our membership fees increasing in conjunction with rising insurance renewal premiums due to either damage or repair at the field.

One small task that we <u>all</u> agree too during our **joining induction**, which includes a **safety brief,** is to open both the **TX (transmitter) Compound** and **Unisex (ACROD) Toilet** adjacent to the canteen.

The *combination code* to both the **Main Gate** and **TX (transmitter) Compound** lock(s) may be found on the reverse of your **WAMASC 2015 membership card**.

<u>If you are the first to **arrive** at the field</u> you are asked to open the **TX (transmitter) Compound** in which you will find the key to the **Unisex (ACROD) Toilet** (the key to the toilet is kept on a string internal of the **TX (transmitter) Compound** and should be returned post opening the toilet).

The requirement for the **TX (transmitter) Compound** to be open when personnel are in attendance at the field is of great *safety importance* as it houses both the **First Aid Kit** and **Defibrillator**.

Conversely <u>should you be the last to **depart** the field</u> you are asked to ensure that the **TX (transmitter) Compound**, **Unisex (ACROD) Toilet** and **Main Gate** are <u>**secured**</u> correctly.