

### Calculating Theoretical Speed.

Theoretical speed means that the propeller is 100% efficient and that there is no loss due to aerodynamic drag, etc.

A perfect airplane flying in a perfect world. That's not going to happen here on earth, but this still gives you a starting point.

For this example we'll use an engine turning a 7" pitch propeller at 15,000 RPM.

Convert Revolutions Per Minute (RPM) to Revolutions Per Hour (RPH):

$$\text{RPM} \times 60 = \text{RPH}$$

$$15,000 \times 60 = 900,000 \text{ RPH}$$

Find Inches Per Hour assuming 100% efficiency:

$$\text{RPH} \times \text{Propeller Pitch} = \text{Inches per Hour}$$

$$900,000 \times 7 = 6,300,000 \text{ inches per hour}$$

Convert to Miles Per Hour (12" x 5280' = inches in a mile):

$$6,300,000 \div (12 \times 5280) = 99.4 \text{ MPH}$$

The bottom line (assuming 100% propeller efficiency and zero airframe drag):

$$\text{Speed} = (\text{RPM} \times \text{Pitch}) \div 1056$$

In reality the average sport model with this combination might do 75-80 MPH on a good day.

### Calculating Propeller Efficiency.

Going a little farther, we can actually set up a speed trial to determine how fast an aircraft is going and then determine propeller efficiency using those numbers (time over distance).

So let's say you time your aircraft on a 100 yard (300 feet) course (upwind and downwind to make it even). The average time is 2.7 seconds.

Convert the distance covered to miles by dividing distance covered in feet by number of feet in a mile.

There are 5,280 feet in a mile.

$$300 \div 5280 = .0568 \text{ miles}$$

Convert elapsed time to hours by dividing time in seconds by seconds in an hour. There are 3600 seconds in an hour.

$$2.7 \div 3600 = .00075 \text{ hours}$$

Find Miles Per Hour:

$$.0568 \div .00075 = 75.7 \text{ mph}$$

If our timer was accurate and the distance is accurate then that speed will be accurate. An easier way is to use a radar gun, but then you don't get to do all this fun math.

Going back to the previous example, let's determine the overall loss of efficiency and then, for convenience, blame it all on the propeller.

Divide actual speed by the theoretical speed using a 100% efficient propeller and an aircraft having zero drag:

$$75.7 \div 99.4 = 76.16\% \text{ efficiency}$$

Unless we have an onboard tachometer, we do not really know what the RPM of the engine is. Also, the lack of efficiency could very easily be attributed to the airframe design - not necessarily the fault of the propeller. Still, it is something to play around with if you are so inclined.

### APC Suggested RPM Limits

#### Glow Engine and Thin Electric Props ( includes Folding Electric)

Maximum RPM=190,000/prop diameter (inches)

(For example, a 10x6 glow engine prop should be limited to 19,000 RPM)

#### Slow Flyer props

Maximum RPM=65,000/prop diameter (inches)

#### Racing Props

8.75 N,W and 8.8 series 40 Pylon props

Maximum RPM=225,000/Prop diameter (inches)